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A Psychophysiological Study of Visuospatial Cognition In Individuals At Risk For Developing Alcoholism

by

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Abstract

It has been suggested that alcoholism may be related to right cortical hemisphere deficits, but it is not yet known if or how these deficits may be associated with the development of alcoholism. In the present study, it was of interest to determine if both family risk and psychometric risk for alcoholism were related to right hemisphere dysfunctions. Forty-seven male subjects were placed into either family-risk, psychometric risk, or non-risk control groups. They completed two types of tasks: visuospatial Search and smooth pursuit eye movement (SPEM) tasks. Event related potentials (ERPs, the N1 and P2 components) were recorded to tone probes while the subjects were performing the visual Search tasks. During SPEM, P300 peaks were recorded in response to a visual target change. The most striking finding was that the two risk groups demonstrated abnormally high cortical activity, particularly over the right hemisphere during both types of tasks. The risk groups also demonstrated right-sided hemi-inattention during nonverbal Search, perhaps due to this right hemisphere hyperarousal (which may have resulted in left hemisphere inhibition causing contralateral inattention). The implication of these findings may be that young men at risk for alcoholism

experience general arousal and attentional difficulties related to the right hemisphere, which might not only hamper their ability to perform visuospatial tasks, but may make alcohol particularly rewarding. Alcohol consumption may reduce arousal and improve attention-dependant performance. The relationships among risk for alcoholism, risk for other psychopathologies; and drinking behaviors and expectancies were also extensively investigated. The major findings and implications were discussed.

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A Psychophysiological Study of Visuospatial Cognition In Individuals At Risk for Developing Alcoholism

Alcohol abuse and dependence continue to be problematic in North American society, as they contribute to health problems, family disruptions, traffic accidents, and problems at work and school. It is imperative that we discover what predisposes some individuals to alcohol abuse and dependence in order to help prevent the development of addiction to alcohol.

It is believed that there are several risk factors that may influence an individual or make one vulnerable to developing alcoholism. For instance, heredity is likely a significant contributor to one's susceptibility (eg. Tarter, 1988). It is not yet known what is actually inherited that would put an individual at risk, but there is increasing evidence that those who have alcoholic parents may have cognitive and psychophysiological abnormalities (eg. Begleiter, Porjesz, Bihari and Kissin, 1984; Schandler et al., 1988) and these may contribute to, or be a marker for their vulnerability. Particular personality factors, such as hostility and impulsivity, seem to be related to alcoholism (Cloninger, Sigvarsson, and Bohman, 1988; MacAndrew, 1979). Do those whose personalities and beliefs that may predispose them to alcoholism also have

similar neurocognitive and psychophysiological deficits? That is, perhaps personality characteristics that are related to alcoholic vulnerability are related to those abnormalities that have been found in genetically at-risk individuals. The purpose of this study was to attempt to replicate and extend some previous findings regarding the psychophysiological and cognitive abnormalities found in those with alcoholic relatives. Those who may be prone because they possess unusual personality characteristics were compared with those demonstrating familial risk on two visuospatial tasks in order to determine if an "alcoholic personality" is related to the deficits found in alcoholics and their first degree relatives.

The high risk or vulnerability paradigm is useful as it allows one to investigate predispositions to psychopathology. Depue (1981) outlined the various approaches to this model. One can study vulnerable "genotypes", those who have affected parents. One can use an "endophenotypic" approach, and study those individuals with actual biological markers (such as electrocortical abnormalities). It must be determined what the important biological markers are however, which is often difficult. Depue suggests that using those with a particular behavioural manifestation of a genetic

marker (the "exophenotypic" approach) such as characteristic responses on a personality questionnaire, is a more concise, economical, and efficient approach for studying psychopathology. In the present study, I compared at-risk genotypes (those who had alcoholic fathers and other male alcoholic relatives) with exophenotypes, those who manifested personality characteristics associated with alcoholism on some neurocognitive and psychophysiological measurements.

There are many potential psychological risk factors for the development of alcoholism. One's expectancies regarding the effects of alcohol have been found to be related to one's drinking habits. For example, Brown and her associates, (Brown, 1985; Brown, Christiansen and Goldman, 1987; Christiansen, Goldman and Brown, 1985) have found that generally, those who expect more positive consequences or effects with consumption are likely to drink more than those with neutral or negative beliefs about the effects of alcohol. Alcoholics have more positive attributions about consumption than non-alcoholics. They believe that alcohol increases relaxation, improves cognitive and motor functioning, enhances sexuality, increases arousal, and enhances social behaviour (Christiansen et al, 1985). Among university students, those who expect

tension reduction with consumption are more likely to be problem drinkers (Brown, 1985). It is evident that attitudes regarding the effects of alcohol are related to patterns of, and in some cases, problems with drinking.

Related to this, particular personality characteristics have been found to be associated with the risk for alcoholism. It has been widely demonstrated that alcoholism is associated with impulsivity, sensation-seeking, and antisocial behaviours. Labouvie and McGee (1986) found that adolescents who scored highly on impulsiveness, autonomy, affiliation, exhibitionism, and play (on Jackson's Personality Inventory) drank relatively heavily compared to those with low scores. In a longitudinal study, Cloninger et al. (1988) found that high sensation-seeking, distractibility, sociability and disruptiveness, in combination with uninhibited, carefree behaviour was the personality profile most associated with early onset (under age 27) alcoholism. Graham and Strenger (1988) provided a review of the studies that employed the Minnesota Multiphasic Personality Inventory (MMPI), and concluded that the most consistent finding was that alcoholics score highly on Scale 4 (Pd, psychopathic deviate) suggesting that they are more antisocial,

rebellious, hostile, irritable, and impulsive. MacAndrew (1965) developed an MMPI-based questionnaire, called the MacAndrew Alcoholism Scale (MAC scale), which has been found to be a reliable detector of alcoholism among young men (MacAndrew, 1979; Davis, Colligan, Morse, and Offord, 1987). This scale measures uninhibited and non-conformist behaviours. Tarter (1988) provided evidence that particular personality traits such as impulsivity and neuroticism are found in children of alcoholics (COAs), and may be genetically inherited, perhaps contributing to risk for alcoholism.

Therefore, antisocial personality characteristics appear to be related to the development of alcoholism. As one would expect, the psychopathology that has been found to be most common among male alcoholics is antisocial personality disorder. Heltzer and Pryzbeck (1988) found that every psychiatric disturbance (approximately 200 in the entire DSM-III taxonomy) that they assessed was more likely to occur in association with alcohol abuse and dependence. The likelihood for having antisocial personality disorder was higher than any other diagnosis among men. In a meta-analysis of the literature on drug use, alcoholism, and antisocial personality, Schubert et al (1988) reported that all three disorders were correlated with one another,

suggesting that if alcoholism, drug abuse, or antisocial personality disorder is present in an individual, it is likely that another of the three will also co-occur. There is some suggestion that male alcoholics with antisocial personality disorder have a more serious addiction to alcohol and more alcohol-related problems (Yates, Petty, and Brown, 1988). Ross, Glaser and Stiasny (1988) surveyed male and female alcoholics in order to compare their differences in psychiatric diagnoses. Among female alcoholics, anxiety, psychosexual problems and bulimia were the most common psychiatric diagnoses, while among men, antisocial personality disorder was the most common.

Having a parent with antisocial personality disorder may make one more susceptible to childhood psychopathology. Earls, Reich, Jung and Cloninger (1988) reported on the rates of psychopathology among children (ages six to to 17) of alcoholics and those with antisocial personality disorder. The children of alcoholics (COAs) received significantly more DSM-III diagnoses, such as hyperactivity and conduct disorder, and this rate increased if a child had two alcoholic parents. Parental antisocial personality disorder also increased the risk for childhood psychopathology, but two thirds of the antisocial parents (all fathers) were

also alcoholic. Earls and his associates found that the rate of childhood psychopathology did not differ between offspring of alcoholic and antisocial parents, but since most of the antisocial fathers were also alcoholic, the relationship is not yet clear.

Having alcoholic parents also makes one more vulnerable to becoming alcoholic. For example, Drake and Vaillant (1988) found that by mid-life, 28 percent of the offspring of alcoholics had developed alcohol dependence, twice the number compared to non-COAs. Volicer, Volicer and D'Angelo (1983, 1984) found that COAs develop alcohol dependence earlier than non-COAs and seem to be more severely addicted. Although substance abuse was not directly assessed, Reich, Earls and Powell (1988) found that the home-life of the COAs was significantly more conflicted than the home-life of the non-COAs. Many of the COAs received a DSM-III diagnosis, and many were physically abused. It appears that having an alcoholic parent significantly affects offspring, and may increase the risk for developing alcoholism. However, in these studies, no attempt was made to determine whether genetics or environment plays a more significant role in vulnerability for alcoholism.

There is substantial evidence that vulnerability to alcohol dependence is transmitted genetically,

particularily among sons of alcoholics (eg. Drake and Vaillant, 1988; Schuckit, 1987; Tarter, 1988). A large portion of the research that has been completed on the heritability of alcoholism has been conducted in Sweden with adopted offspring of alcoholics. When compared to sons of non-alcoholics, sons with alcoholic fathers have a three to four times greater heritability rate, tend to develop alcoholism at an early age (less than 25), are often arrested for aggressive behaviour, and are more impulsive and novelty seeking, regardless of adoptive status (Cloninger, Bohman, Sigvardsson, 1981; Cloninger, 1983; Cloninger, Sigvardsson, Knorring, and Bohman, 1988). Cloninger and his associates assert that there are two types of alcoholism. Type 1 does not seem to run in families, is more related to loss of control, fear and guilt regarding drinking, and is not associated with antisocial behaviours. Type 2 is male limited, runs in families, and is associated with earlier onset alcoholism, more severe addiction, and antisocial behaviours (Cloninger et al, 1988). Thus, severe alcoholism likely runs in families, and some aspect of vulnerabilty is passed on to the next generation.

Alcoholics and their relatives appear to have many similar characteristics that may be markers of susceptibility to alcohol dependence. The characteristic

neurocognitive and psycho-physiological markers, the primary foci of this study, will be discussed in detail below. There is some evidence that male COAs respond differently to alcohol than male non-COAs. For example, Schuckit (1988) reported that sons of alcoholics and sons of non-alcoholics metabolized alcohol similarily, but at low doses, the non-COA subjects reported more drug effect and experienced more body sway. After larger doses of ethanol, two hormones (serum cortisol and prolactin) remained higher in non-family risk group individuals. Similar effects were reported by Savoie, Emory, and Moody-Thomas (1988). Men with a positive family history for alcoholism did not report a central stimulant effect from alcohol, and felt less anxious after ingestion. Negative family history men and both groups of women reported more stimulation and more anxiety with alcohol, suggesting that men with alcoholic fathers respond differently to small amounts of alcohol intake. Levenson, Oyama, and Meek (1987) found that both male and female offspring of alcoholics experienced a greater stress dampening effect with alcohol consumption, both in terms of subjective distress and cardiovascular response.

It must be noted that Alterman, Searles and Hall (1989) have recently replicated their research findings

which suggested that sons of alcoholics are not different from sons of non-alcoholics in terms of drinking behaviours, personality and cognition, drug use, or mental health problems. The only group difference was that sons of alcoholics reported more attentional and social problems in childhood. Thus, it is not yet clear what differentiates sons of alcoholics that puts them more at risk for developing alcoholism.

Most researchers studying the behaviours of COAs have not attempted to differentiate between offspring of Type 1 and Type 2 alcoholics, and perhaps should. This is evident with the results from Finn and Pihl's (1987, 1988) research. They have discovered that response to alcohol depends on whether one comes from a multigenerational alcoholic family or whether one has only an alcoholic parent. Men with alcoholic fathers and grandfathers were more reactive to electric shock while sober (as measured by cardiovascular response) than were sons from non-alcoholic families and sons with only an alcoholic parent. With consumption of alcohol, the multigenerational young men reacted less to the shock than did the other two groups suggesting a stronger stress dampening effect of alcohol in these subjects. These results concur with Cloninger's thesis that Type 2 alcoholism is more severe and runs in families.

Perhaps, as Finn and Pihl have found, just having an alcoholic parent may not put one at risk for developing alcoholism or inheriting biological characteristics that increase vulnerability for alcoholsm.

As mentioned above, the present study deals primarily with the investigation of markers of alcoholism. Because of increasing evidence that alcoholics and their sons respond similarily on neurocognitive and psychophysiological tasks, these measurements may be useful vulnerability markers. Beigleiter and Porjesz (1988) suggested that electrical brain potential abnormalities are appropriate vulnerability markers for alcoholism because they meet several necessary criteria. They can be measured reliably, and are stable over time. They have been shown to be genetically transmitted, and abnormalities of these measures show a low rate of occurrence in the general population, and identify those at risk. Electrical brain potential abnormalities have been found to be unusually prevalent in alcoholics, are present when abstinent, occur at a higher rate among first degree relatives of alcoholics than among the general population (late evoked potentials abnormalities have been found in 87 percent of sons of Type 2 alcoholics) (Beigleiter and Porjesz, 1988). Perhaps the electrical

brain potential abnormalities are related to the characteristic cognitive deficits found in alcoholics.

The right cerebral hemisphere, particularily the posterior parietal cortex, is believed to be critical in the visuospatial aspects of behaviour and perception, such as visually guided motor activity and the spatial aspects of attention (Anderson, 1988). Alcoholics have been found to have several cognitive deficits, particularily problems with visuospatial and abstraction skills, suggesting that they may possess right hemisphere damage. Leber and Parsons (1982) provided a concise review and summary of empirical research that supports this contention. Bertera and Parsons (1978) found support for both right hemisphere and frontal lobe damage in alcoholics by using a visual search paradigm. In their study, alcohol and control subjects were shown a letter trigram or a shape, and were then immediately shown a random display. They searched the display and pointed at the target as soon as it was detected. Thus, speed, accuracy and efficiency were all of interest. Detoxified long- and short-term alcoholics performed both the verbal and non-verbal form of the task more slowly and made more errors in the periphery of the array compared to non-alcoholics. The authors claim that this may be evidence in support of the hypothesis that

the frontal lobes in alcoholics may be damaged. The long term alcoholics made more errors overall (pointing to the incorrect trigram or shape), particularily in the left-hemispace, and were slower at detecting targets in the left hemispace too, supporting the hypothesis that alcoholics may have right hemisphere dysfunction.

That male alcoholics have problems with visuospatial tasks is supported by several other researchers. Fabian, Parsons and Sheldon (1984) compared male and female alcoholics with non-alcoholics on the Stark task, a paired associate learning task comprised of verbal and visuospatial versions equated for difficulty. Male and female control subjects performed as expected, with males making far more verbal than visuospatial errors, and females making far more visuospatial than verbal errors. The males showed a greater difference in performance between the two versions of the task than did females, supporting the notion that males may be more lateralized for verbal and visuospatial cognition than females, and that males are more adept at visuospatial skills. The female alcoholics performed similarily to their matched controls, but made slightly more errors. The male alcoholics, however, performed better on the verbal than the visuospatial version of the Stark task, performing similarily to both

groups of females, but committing slightly more errors. Their verbal performance was marginally better than that of their matched controls. The authors suggested that male alcoholics have trouble with right hemisphere mediated visuospatial tasks due to prolonged alcohol abuse.

Some researchers have attempted to determine if length of abstinence from alcohol affects cognitive performance. Emmerson, Dustman, Heil and Shearer (1988) found that short-term abstinent alcoholics performed more poorly than non- and social drinkers and more poorly than long-term abstinent alcoholics on a variety of cognitive tasks, particularly on visuospatial performance measures. This suggests that withdrawal from alcohol during short-term abstinence may reduce cognitive performance. When alcoholics were compared to non-alcoholics, it was found that alcoholics had lower WAIS vocabulary scores, as well as reduced performance on Trail making from the Halstead Reitan battery, a test of visuomotor sequencing ability and visuomotor tracking. The vocabulary score difference may be explained by the lower level of education in the alcoholics, since this test taps general knowledge as well. Similar results were found in a study by Page and Cleveland (1987). Long- and short-term abstinent

alcoholics were differentiated from non- and social drinkers by poorer performance on the WAIS Digit Symbol, Block Design and Vocabulary tests. Again, the long-term abstinent alcoholics outperformed the short-term abstinent alcoholics. Perhaps long term abstinence allows some recovery of function, or alternatively, those alcoholics who can only maintain short-term abstinence may be cognitively more deficient than those who are able to remain abstinent for prolonged periods. Appropriate longitudinal studies are necessary to determine whether native ability or length of abstinence is more strongly related to cognitive performance in alcoholics.

It has generally been assumed that prolonged alcohol abuse causes brain damage and thus creates the right hemisphere deficits commonly found in alcoholics. However, this may not be the case. Schandler et al (1988b) compared intoxicated and detoxified alcoholics with similar drinking histories on complex visuospatial learning of nonsense shapes. Normal individuals demonstrate elevated heart rates and skin conductances while learning which level off when learning is complete, termed "activation peaking". The detoxified alcoholics had difficulties learning the task and showed abnormal activation peaking. The intoxicated alcoholics

learned the task more easily and demonstrated appropriate autonomic responses while learning the task compared to the detoxified alcoholics. Schandler and his associates suggested that alcoholics have deficient visuospatial experiences that are somewhat "normalized" by drinking. It is evident that alcohol abuse may not cause the characteristic cognitive deficits. Instead, these deficits may precede the onset of alcoholism.

Further evidence that cognitive deficits precede alcoholism is supported by research conducted with the offspring of alcoholics. COAs, who are not yet alcoholic, manifest visuospatial and abstraction deficits that are similar to those found in alcoholics. Whipple, Parker, and Nobel (1988) found that ten-year old sons of alcoholics had poorer performance than matched controls in the Embedded Figures, Block Design and Object Assembly tasks from the WAIS. The deficient performance of the COAs was correlated with the fathers' performance, suggesting that some genetically mediated factor may be responsible. Possible CNS correlates, such as right hemisphere dysfunction, were not discussed by Whipple and his associates. Schandler et al. (1988a) reported that elementary school-aged boys and girls from multigenerational alcoholic families had difficulties with visuospatial paired associate learning, when

compared to matched non-COAs. They took longer to complete the task and committed more errors, performance that resembled that found in the detoxified alcoholics in their previous study (Schandler et al., 1988b). These authors hypothesized that the cognitive deficits that were demonstrated by the COAs in their study may be due to some right hemisphere dysfunction, and suggested that direct measurement of right-hemisphere activity of COAs is necessary.

Drejer et al. (1985) found few cognitive differences between COAs and non-COAs. Their neuropsychological battery included tests of verbal and visuospatial skills, memory, attention, catogorizing, and planning. They did find that the sons of alcoholics had difficulties with conceptual shifting, impulse control, and had more rigid problem solving techniques relative to the non-COAs (as determined by more errors on the Halstead Categories and Porteus Maze tests). The COAs also demonstrated poorer vocabulary skills, but no interpretation was offered by the authors. More recently, Tarter (1989) administered several cognitive tasks to sons of alcoholics and matched controls. The COAs demonstrated poorer planning and visuomotor capacity, lower perceptual speed under conditions of distraction, poorer visual scanning and psychomotor

efficiency, more body sway, and greater impulsivity relative to the non-COAs. The authors concluded that the COAs demonstrated deficient anterior cortical functions. It is difficult to interpret such different findings between these two studies. In the former, the subjects were young men, and they were not excluded if their fathers had a secondary diagnosis (such as psychopathy). In the latter study, the subjects were children, and sons of those alcoholics who were diagnosed as having antisocial personality disorder were excluded, as were sons of alcoholic mothers. It seems as though the latter study was more carefully controlled in terms of parental psychopathology.

Schaeffer and his associates (Schaeffer, Parsons and Yohman, 1984; Schaeffer, Parsons and Errico, 1988) have demonstrated that the family history of alcoholism significantly affects the cognitive performance of one who is currently alcoholic. Alcoholism and family history of alcoholism both exerted a main effect on cognitive performance, and seemed to have an additive effect because those men who were both alcoholic and had an alcoholic parent had the most significant deficits. Only deficits in abstraction/problem solving and perceptual-motor skills were found in the alcoholic and family risk men.

It is not yet clear how abstraction and visuospatial deficits that may alter one's cognitive experiences are related to a potential increased risk for alcoholism. As electrocortical activity has been found to be related to cognition (Picton, Campbell, Baribeau-Braun, and Proulx, 1978), and as alcoholics and their sons have been found to demonstrate abnormal brain electrical activity (Gabrielli et al., 1982; Begleiter et al, 1984; Whipple, Parker and Noble, 1988) perhaps abnormal hemispheric activation accounts for the deficient visuospatial performance.

Electrocortical activity can be used as a reliable index of cognitive processing. A non-invasive measurement of electrocortical activity is the event-related potential (ERP), which has several components. A stimulus encountered in any modality will elicit a sudden change in scalp-recorded electrical brain activity. The first significant peak has a negative polarity and occurs approximately 100 msec post-stimulus, called the N100 (N1). This is followed by a large positive wave approximately 200 msec post stimulus, called the P200 (P2). This N1-P2 complex has generally been attributed to activity in the primary sensory pathways, but can be modified by attention. If one directs more attention toward the stimuli (such as a

repetitive tone pip), both voltage changes in the N1 and P2 peaks occur, as well as an overlapping negativity referred to as the processing negativity or Nd (Naatanen and Picton, 1987). Nd can begin approximately 50 msec after the stimulus is encountered, and may last a few hundred milliseconds. It is believed that Nd is not under voluntary control (Naatanen, 1982). Thus, more attention to the tones creates Nd, which results in increases in the N1 peak, and decreases in the P2 peak.

The N1-P2 complex can be used in the "probe ERP paradigm" to measure cortical activity during a cognitive task (Papinicolaou and Johnstone, 1984). In this paradigm, ERPs are recorded to irrelevant stimuli while the subject performs a complex task. Therefore, this is a dual or divided attention task because attention must be allotted to not only the primary cognitive task, but the brain will also respond to the tones. The probe ERP paradigm is based on limited capacity, multiple resources model of information processing, which assumes that there are finite processing resources in cortical regions involved in the cognitive task. Therefore, the amplitudes of ERPs in response to irrelevant tones can be an index of the magnitude of attention allotted to the cognitive task. If one area of the brain is more taxed by the cognitive

task, then this region will respond less to the probes. Alternately, the regions of the brain which are not as involved in the task will elicit greater negativity of the N1-P2 complex.

The probe paradigm has clinical applications as well. For example, Shucard, Cummins, and McGee (1984) reported that adolescent males with reading disabilities showed abnormally decreased right-hemisphere engagement during reading tasks and abnormally increased left hemisphere engagement during a visual-phonemic transfer task. This suggests that these learning disabled boys had dysfunctional hemispheric activation.

Jutai, Chwyl, and Chou (1988) found that the probe paradigm was useful in assessing hemispheric activation during visual search. The right hemisphere responded less to the tones than the left, suggesting that the left hemisphere was less engaged or less taxed by the search task. It was also found that search strategy was directly related to ERPs. An efficient search strategy implies that the subject scans the array in an organized fashion, usually in a left to right and top to bottom manner. Those subjects who manifested an inefficient search strategy had lower P2 amplitudes in the right hemisphere, indicitive of a decreased ability to ignore irrelevant tone pips during a task that employs right

hemisphere resources. Thus, those who were unable to conduct the search task efficiently seemed to have dysfunctional right hemisphere activity. The probe paradigm may be useful in determining if those at risk for alcoholism demonstrate dysfunctional right hemisphere activation during visual search.

Most of the research involving ERPs and alcoholism have included an examination of P300 abnormalities, another electrocortical index of cognition. If the experimental paradigm involves the detection of a target stimulus or the perception of a novel stimulus, the N1 and P2 will occur, as will a large positive wave, peaking approximately 300 msec (called the P300) after the occurrence of the stimulus (Knight, 1985, Picton et al., 1978). The amplitude (or voltage) of the P300 is an index of initial information processing and attention, and if disrupted or absent, this may be a clinical marker for some cognitive deficits.

P300 abnormalities, particularly reduced amplitudes, seem to be affected by chronic alcohol consumption. In a study with alcoholics, complex visual stimuli, varying in several dimensions, were presented to the subjects. They were to count the number of times two consecutive presentations matched in all aspects. In response to the detection of this "target", visual P300s

were decreased in amplitude in alcoholics, relative to non-alcoholics (Whipple, Parker and Noble, 1988) suggesting reduced cognitive capacity in alcoholics. Branchey, Buydens-Branchey, and Lieber (1988) studied the P300 response to a two-tone auditory discrimination task in sub-populations of alcoholics. The authors found that the alcoholics who had high genetic loadings for alcoholism and who had been incarcerated for violent crimes had the worst decrement in P300 amplitudes. Thus, both family risk, and antisocial, aggressive personality risk influenced these alcoholics' psychophysiological responses.

Begleiter and Porjesz, in their 1985 review paper, asserted that chronic alcoholism is associated with a decrease in the amplitude of the P300 peak, and that the attenuation is evident even after prolonged abstinence. The latency of the P300 seems to be increased by alcohol intake, and returns to normal in long term abstinent alcoholics (Begleiter and Porjesz, 1985). These data suggest that alcohol intake reduces the brain's capacity to attend to or process incoming information, and may be related to the cognitive performance deficits experienced by alcoholics. Prolonged intake may damage the brain permanently. However, psychophysiological research with COAs suggest that ERP abnormalities may

precede the onset of alcoholism.

What is of the most interest to the present study is that sons (boys, adolescents and adults) of alcoholics display abnormalities in their ERPs. P300 amplitudes have been found to be decreased (when compared to the cortical responses of sons of non-alcoholics) in the male offspring of alcoholics during complex visual discrimination and processing tasks (Begleiter, Porjesz, Bihari and Kissin, 1984; O'Connor, Hesselbrock, Tasman, and DePalma, 1987; Whipple, Parker and Noble, 1988). The subjects in O'Connor's et al. (1987) study performed two tasks. In the first, P300 peaks in response to targets were recorded during a visual mental rotation task. COAs had reduced P300 responses at all midline areas as well as at P4 (the right parietal region) when compared to non-COAs. The authors suggested that this reduction in P300 at P4 for the risk group compared to the non-risk group may be indicitive of hemispheric asymmetry across groups, but offer no further hypotheses (such as reduced right hemisphere activity). In the second task, involving visual tracking and perceptual-motor coordination, subjects pressed a button in response to target detection. Again, P300 peaks were reduced in amplitude for the COAs at all midline leads, but no right or left

hemisphere data were included. Performance data (reaction time and error rates) did not differentiate risk- and non-risk groups, but the authors did not offer an explanation why their high risk subjects manifested no visuospatial deficits while many studies have found such deficits in sons of alcoholics. The results of all these studies suggest that even before prolonged alcohol abuse, at-risk individuals have decreased cognitive capacity (as measured by psychophysiological dysfunction), particularily for visuospatial right-hemisphere types of information processing.

In the studies mentioned above, the latency of the P300 was not found to differ with family history of alcoholism, suggesting that latency abnormalities are not associated with risk. It must be noted that Begleiter et al. (1984) did find performance deficits in the high risk subjects. The two groups did not differ in reaction time, but the COAs made significantly more errors in detecting the target in the mental rotation task. In Whipple's et al. (1988) study, performance on the complex visuospatial matching task was not mentioned, but performance deficits were found in the high-risk subjects on the various neurocognitive tasks they administered (see above). In this study, correlations were found among P300 amplitude attenuation

and cognitive performance problems in the high risk sons, and also with the alcoholic fathers' responses, suggesting that there is a strong inter-relationship among family risk for alcoholism, cognitive performance, and psychophysiological abnormalities. However, correlations between performance on the task which is used to evoke ERPs and ERP abnormalities remains to be a contentious issue. Some investigators (Polich and Bloom, 1988a, 1988b; Polich, Haier, Buchbaum, and Bloom, 1988) have not found support for the contention that sons of alcoholics have reduced P300 amplitudes, but in these studies, the tasks involved discrimination of simple auditory and visual stimuli, perhaps too easy to draw out group differences.

From the preceding review, it is evident that young male offspring of alcoholics have deficient psychophysiological and neurocognitive responses on visuospatial, right hemisphere tasks. These might prove to be reliable markers for vulnerability to the development of alcoholism. Perhaps hemispheric activation is disrupted in some manner which reduces the capacity to attend to or to perform visuospatial tasks.

Another neurocognitive skill that may be related to visuospatial performance and hemispheric activation is smooth-pursuit eye-movement (SPEM), the eye movement

associated with following a regularly moving target. It is evident that moderate and large doses of alcohol administered to non-alcoholics affects SPEM, particularly by increasing saccadic eye movement, causing SPEM to become jerky and inefficient (Wilkinson, Kime, and Purnell, 1974; Levy, Lipton, and Holzman, 1981). SPEM has been measured in alcoholics by Kobatke et al. (1983), and it was found that eye movements were distorted by saccadic intrusions. The authors did not mention if the alcoholics had gone through withdrawal. It was assumed that prolonged alcohol abuse created the disruption of SPEM, but it may be that eye movement problems are related to the visuospatial and psychophysiological disabilities found in alcoholics, which may precede the onset of alcohol addiction.

Recently pilot studies in our lab have shown that P300 amplitudes (in response to a shape change of the target) recorded over the right and left hemispheres during SPEM differed, depending on the direction of the target. Specifically, when one is following a target moving left, the P300 response in the left hemisphere is larger in amplitude. Likewise, when one is tracking a rightward moving target, the P300 response to a shape change is larger in the right hemisphere. Studies of patients with unilateral brain damage indicate that

horizontal SPEM is impaired in the direction ipsilateral to brain damage (DeRenzi, 1982). Our pilot findings support the notion that shifts in relative hemispheric activation are associated with normal SPEM efficiency. The abnormalities observed in brain-damaged individuals may result from unilateral hypoarousal. If alcoholism-risk subjects possess right hemisphere dysfunction, they may manifest abnormal right hemisphere P300 amplitudes in such a SPEM task, or may not show the characteristic hemisphere asymmetry seen in normals.

It is clear that having an alcoholic father increases the likelihood that one responds abnormally to neurocognitive tasks, and increases the likelihood of developing alcoholism. It is also likely that specific personality characteristics are associated with an increased chance of developing alcoholism. However, it is not clear whether personality, as determined by psychometric tests, also predicts similar neurocognitive deficits that may contribute to alcohol addiction vulnerability. Levenson, Oyama, and Meek (1987) compared the stress dampening effects of alcohol among those who were genetically at risk, psychometrically at risk, those who had both risk factors, and normal controls. They determined that all three risk groups experienced increases in the stress-dampening effects of alcohol. It

would therefore be interesting to compare four similar groups on neurocognitive and psychophysiological functioning.

The purpose of the present study was to discover what elements of alcoholism vulnerability such as family background, personality factors as determined by psychometric tests, or a combination of the two, were most related to abnormal neurocognitive and psychophysiological responses to tasks which are primarilily visuospatial in nature. It was of primary interest to discover if these risk subjects possessed abnormal hemispheric activation while performing a visual search task and a SPEM task . Further, the relationship between alcoholism risk and other major forms of psychopathology was investigated. There may be an association between alcoholism and depression (Weissman and Myers, 1980), but it is difficult to determine the direction of this relationship. It was important, therefore, to determine if risk for alcoholism is related to mood disorders. Likewise, it was critical to determine if risk for alcoholism is related to psychosis proneness, although the literature reviewed above suggests that alcoholism is associated with antisocial personality disorder, and not risk for schizophrenia. Also, it was of interest to determine if

expectancy regarding positive effects of alcohol was related to risk for alcoholism in order to help determine psychometric responses or co-predictors in the three types of risk. As Depue (1981) mentioned, the exophenotypic method of detecting risk is economical and efficient, and should continue to be explored. Finally, drinking behaviours were compared among risk groups to determine if different measures of risk for alcoholism are related to quantity and frequency of alcohol consumption, and experiences with serious consequences of alcohol use.

In this study, ERPs were recorded during two types of tasks. The first was a visual search cancellation task, in which subjects were to detect verbal or non-verbal targets in a random array. While performing this task, they heard repetitive tone beeps binaurally which they were to ignore. The amplitudes of the N1 and P2 components of the auditory ERP were recorded in response to the tones. In accordance with the probe ERP paradigm, it was of interest to determine which hemisphere was less responsive to the tones, and therefore which was more involved in the search task. Subjects also completed a simple "warmup" task which served as a baseline for lower level, perceptual-motor components of the search tasks.

For the Control group subjects, it was expected that the right hemisphere ERPs in the search tasks would show a smaller negative shift relative to the left hemisphere in response to the auditory probes, because the right hemisphere is likely more involved in visual search and thus less responsive to the tones. Attenuation of the N1-P2 complex in the right hemisphere was expected to be more evident in the non-verbal than the verbal version of the task, because it is likely to draw on more right hemisphere resources. Because the Warmup task is primarily perceptual-motor in nature, ERP asymmetry was not expected. The negative shift in the N1-P2 complex was expected to be smaller during the search tasks compared to responses during the Warmup task, since subjects would be more attentive to the primary tasks in the former and hence less responsive to the probes.

It was expected that those who are vulnerable to alcoholism would display differences in their psychophysiological responses and cognitive performance during the visual search auditory probe task. Since there is a suggestion for right hemisphere damage in family-risk individuals, it was expected that this right hemisphere attenuation of the negative shift would occur to the same degree, or may not occur at all. It was also

hypothesized that the at-risk young men will show poorer performance (slower, less accurate, less systematic search strategy). The non-risk group should perform better than this group in all respects. Finally, with regards to the search performance measures, it was of interest to investigate whether at-risk individuals demonstrated hemispatial neglect; that is, perhaps risk for alcoholism (and subsequent right hemisphere dysfunction) makes one more likely to commit more left-hemispace errors.

The second type of task was a SPEM task. In the first version (Ignore), subjects followed a small square back and forth across a video screen. The square changed shape periodically into a plus sign, but subjects were to ignore the change. In the second version of the SPEM task (Press), the subjects pressed a button when they detected the shape change. SPEM tasks provide an opportunity to examine cortical activation during a visuospatial task in which eye movement (oculomotor) activity is highly controlled (because of the requirement to track a moving target). During visual search, eye movements are not controlled. It was important to determine if abnormal hemispheric activation in risk groups might be general to visuospatial performance, or specific to tasks in which

it may be influenced by group differences in oculomtor activity, perhaps related to differences in scanning strategies.

The hypotheses for this part of the study were as follows: In the non-risk Control subjects, it was expected that P300 amplitude would be larger in the hemisphere ipsilateral to the direction of target movement. It was also expected that the Press condition should elicit greater P300 amplitudes than the Ignore condition, because more attention is required. Risk subjects were expected to show unusually small amplitudes in response to target detection, and abnormal hemispheric activation during the SPEM task.

Method

Subject Selection Process

The participants were chosen from among approximately 1300 undergraduate psychology students in Psychology 260/261 who were given a package of questionnaires to complete for course credit. The questionnaires included:

1. The General Attitudes Survey (Appendix A): This scale included

(a) The MacAndrew Alcoholism Scale (MAC; MacAndrew, 1965) This is a 49 item subtest of the Minnesota Multiphasic Personality Inventory (MMPI). It has been found to be the most reliable of all MMPI subtests for detecting alcoholism (Otto, Lang, Megaree, and Rosenblatt, 1988; Davis et al, 1988).

(b) An Alcohol Expectancy Questionnaire (AEQ): This scale was adapted from Christiansen et al. (1985). Forty items from the original scale were used, those that had factor loadings of at least 0.35 on seven factors: social assertiveness (SOCAS), sleep, arousal (ARSL), relaxation (RELX), sexual enhancement (SEXEN), cognitive and motor functioning (COGMOT), and mood as reported by these researchers. A higher score was associated with a positive expectation regarding the effects of alcohol. A total positive expectancy score (TOTAEQ) was also

computed by summing scores on all seven subscales.

2. Background information (Appendix B): This 28 item scale assessed

(a) family information such as marital status and ethnicity of parents, whether the participant was adopted, and the presence of alcoholism among first and second degree relatives.

(b) usual quantity of alcohol consumption at one time (Quantity), and usual frequency of consumption (Frequency). Although other measures of drinking behaviour were included in the questionnaire package, quantity and frequency, being the most widely used among these measures (eg. Levenson et al., 1987) were the only ones used in the data analyses.

(c) the (Brief) Michigan Alcoholism Screening Test (MAST, Pokorny, Miller and Kaplan, 1972). This is a ten-item scale which requires yes/no answers regarding the participant's experience with the consequences of excessive alcohol use. A high score suggests that the subject has experienced more personal problems associated with alcohol consumption.

(d) any head trauma or neurological damage.

3. A questionaire composed of a random mixture of all items from the Physical Anhedonia (PA), Social Anhedonia (SA), Perceptual Aberration-Magical Ideation (Per-Mag)

(PM), and the Impulsive-Non-conformity (IN) scales (Chapman et al, 1976, 1978; Eckblad and Chapman, 1983; Chapman et al, 1984) (Appendix C). These scales were designed to measure psychosis-proneness. Spatial attention and visual search abnormalities have been found to be particularly associated with high scores on the PA and PM scales (Jutai, 1989).

4. A consent form to be contacted for further testing (Appendix D).

Subjects

All participants were male, right handed, between the ages of 17 and 32 (M=20.1, SD=2.7), Caucasian, and were not adopted. According to responses on a medical questionnaire, all subjects were in good health and none were taking any medications other than antibiotics. None reported head injury, problems associated with neurological difficulties, such as headaches or epilepsy, or a family history of mental illness. Subjects reporting having an alcoholic mother were excluded, as prenatal alcohol has been proven to have a teratogenic effect causing brain damage and mental retardation (Jones, Smith, Ulleland and Streissguth, 1973).

Subjects were placed into groups by the presence or absence of family history of alcoholism, and on the

basis of their scores on the MAC scale. MacAndrew (1979) reported that the mean MAC score for university males was 20.22 (SD=3.88), not greatly different from the mean in the present study of 21.6 (SD=4.23, N=502). Levenson et al. (1987) adopted an alcoholism risk cut-off score on the MAC scale of 21 and above, while Davis et al. (1987) used 24 and above as their alcoholism cut-off score. They also attempted to use a lower cut-off score of 21 or more, but found the false positive rate unacceptably high. MacAndrew (1965) recommended 24 as the appropriate cutoff score for alcoholism. However, for the present study, psychometric risk was determined by choosing subjects who scored between approximately one and two standard deviations above the mean on the MAC scale (between 25 and 31), hopefully detecting those with personality risk, but not those who are extremely deviant in the hostility and impulsivity dimensions. Note that there was a statistically significant difference among the groups on the MAC ($F(2,44)=76.4$, $p<.001$). Post hoc Tukey tests (TSD) were conducted to determine where group differences lay. All three groups differed from each other ($TSD(44)=1.39$, $p<.01$); the Psychometric Risk group had a greater score than the other two groups, and the Family Risk group had a slightly higher score than the Control subjects. See

below for descriptive statistics on the MAC scores.

The total N was 53, however the fourth double risk group (N=6) was not included in this report as there were too few subjects available for adequate statistical analyses (N=6). Thus, 47 subjects were included in the analyses. The number of participants in each of the other three groups was chosen to approximately match the maximum number of Family Risk subjects, since they were the most difficult to acquire. For the two tasks, a few subjects had to be excluded from each group due to missing data.

Group 1 was the non-risk Control group. They reported having no alcoholic first or second degree relatives. No one in this group scored above the grand mean on the MAC scale (M=17.8, SD=2.4, range=15-22). This group had 15 subjects, and 14 of them were used for the search and SPEM tasks.

Group 2 was the psychometric risk group (PR; total n=17). Thirteen of them were included in the search task, and 15 in the SPEM task. They reported having no alcohol relatives, and their mean group score on the MAC scale was 26.9 (SD=1.8, range: 25-31).

Group 3 was the family risk group (FR; total n=15, search n=12, SPEM n=15). They reported having an alcoholic or recovering/recovered alcoholic father, as

well as at least one other male paternal alcoholic relative (uncle, brother, or grandfather). All participants in this group scored equal to or below the grand mean on the MAC scale (M=20.2, SD=2.2, range=14-22), and were chosen on this basis in order to reduce confounding of family and psychometric risk.

The 47 participants were contacted by telephone and an appointment was made for them to participate in a laboratory study for course credit. They were not informed why they were chosen, but if they inquired, they were told that we were specifically interested in how individuals with a wide variety of responses on psychometric indices performed on psychophysiological and visuospatial tasks. (If they had more specific questions, they were instructed to contact me or Dr. Jutai once the data were analyzed at the end of the school term). When they arrived, the experiment was explained to them briefly, then they read and signed a consent form. The participants completed the General Behaviour Inventory (GBI; Depue et al., 1985, Appendix E). The GBI is an excellent measure of proneness to unipolar affective disorder and its variants.

The Visual Search Task Materials

A computerized version of the Weintraub and Mesulam Cancellation tests (Weintraub and Mesulam, 1985;

Appendix F) was used. A detailed description of these tasks is provided by Jutai, Aubrey, Roberts, and Finlay (Note. 1). The two search tasks consisted of random arrays of verbal or non-verbal stimuli displayed on a video screen directly in front of the subject at a viewing distance of 60 cm. Each array was comprised of 48 targets dispersed among 256 nontargets. Previous research in our lab using the ERP probe paradigm supports the notion that there is relatively more right than left hemisphere participation in visual search (Jutai, Chwyl, and Chou, 1988).

Procedure

After electrode application (see below), the subject was seated in a comfortable armchair. His head was positioned in a head restraint device with his chin resting on a moulded chin rest. He was instructed to sit as still and relaxed as possible throughout both the visual search and SPEM tasks so that ERP recordings would not be contaminated by movement artifacts. The order of presentation of the two types of tasks (search and SPEM) was counterbalanced across the subjects in each group.

The first condition (Warmup) served as practice, and subjects merely had to cancel all the items (single digit numbers) in a structured array on the video screen

with an electronic light pen. This warm-up task also served as a measure of the degree of disruption of ERPs caused by the motor activity necessary to cancel stimuli, under conditions of minimal requirements for visual search.

The visual search task was then described to the subject. A target item was shown to the subject on the screen, and the subject was asked to memorize it. Next, an array appeared on the screen, and the subject was instructed to cancel all instances of the target with the pen as quickly and accurately as possible. The order of presentation of the verbal and non-verbal versions of the task was counterbalanced across subjects in each group.

Subjects performed the search tasks while being presented with a repetitive series of 98 db, 1000 HZ tone pips delivered binaurally through headphones at a rate of 1.3 per second. Auditory evoked potential data was collected in response to 75 tone pips.

The SPEM Task Procedure

In the first version of the SPEM task (the Ignore condition), the subject was asked to follow an object, a small square box, back and forth across the video screen as accurately as possible moving only his eyes. The square moved at a constant speed of 20 degrees per

second and reversed direction upon reaching the edge of the screen. The box changed shape into a plus sign once during each excursion at a random location. Subjects were to concentrate on tracking the box and ignore the shape change.

In the second version of the task (the Press condition), the subject was instructed to press a button with his index finger on a hand-held box as quickly as possible after detecting the shape-change of the moving stimulus. The hand in which the box was held was counterbalanced across subjects in each group. Subjects engaged in a brief practice session before each condition. In both SPEM tasks, visual event-related potentials were recorded in response to 100 appearances of the target event (shape change).

ERP Recording

Monopolar EEG was recorded from Grass E5GH gold-plated electrodes attached to the participant's scalp with Grass EC2 electrode cream at central left (C3), and central right (C4), parietal left (P3), and parietal right (P4), and the occipital midline (Oz) scalp sites (International 10/20 system), referred to linked earlobes. Bilateral sites were implemented so that electrocortical activity related to attention during search and SPEM tasks could be compared between left and

right hemispheres. Central and parietal areas were recorded from for a few reasons. In response to tone probes, attention-related auditory ERPs are maximal over central (vertex) areas, and the N1-P2 complex and Nd are particularly evident over central and parietal brain areas (Knight, 1985). Also, previous research suggests that the parietal lobes may be the most involved in the visual search tasks (Jutai et al., 1988). P300 ERPs were expected to be maximal over both central and parietal regions, and less large as the distance from these scalp areas increases (Fabian, Gratton, Karis and Donchin, 1987). It was also of interest to ensure that there were no significant group differences in the morphology of the visual ERP recorded from the primary visual cortex (that is, over Oz). Eye movements and blinks were monitored by recording EOG (electrooculogram) from electrodes placed at the outer canthus and just above the eyebrow of the right eye. All sites were cleaned with rubbing alcohol. Electrode impedances were maintained at five Kohms or less, and all channels were recorded with a band width of 0.1 to 30 HZ (6 db down), and sampled on line at 256 HZ. Sampling began 100 msec before stimulus onset and continued for 500 msec (visual search tasks) or 1500 msec (SPEM tasks) thereafter.

Single-trial data were inspected off-line, and

trials with EOG artifact were rejected. Artifact inspection periods were 500 msec poststimulus for search ERPs, and 800 msec poststimulus for SPEM ERPs, just long enough in each case to check for artifacts which might obscure the major ERP components of interest. EOG was averaged along with the EEG for each subject in order to verify the success of this process.

Data Reduction

ERPS for the visual search task

An automatic peak detection programme was used to score: a) amplitude and latency of N1, the peak with the most negative voltage within a 50 to 200 msec poststimulus time window and b) amplitude and latency of P2, the peak with the most positive voltage within a 100 to 250 msec window, subsequent to N1. Amplitude measures were relative to a 100 msec averaged pre-stimulus baseline.

Performance for the visual search task

Six measures of performance were analyzed. The number of targets correctly detected, number of commission errors, total search time, and a measure of search strategy (mean search score) were used to assess how well the subject performed. A "systematic" search strategy generally implies a linear progression through an array, usually in a left-to-right and top-to-bottom

fashion. The search score was the mean product of inter-target detection times and inter-target distance (in pixel units). Systematic search results in faster times and smaller distances and, hence, lower search scores than eratic search. The fifth and sixth measures of performance involved determining whether subjects comitted more errors or omitted more targets on one half of the computer screen (that is, on one half of the participant's perceptual hemispace).

ERPs for the SPEM task

An automatic peak detection programme was used to score: a) amplitude and latency of N250, the most negative voltage peak within a 200-300 msec poststimulus time window, and b) the amplitude and latency of the P300 wave, the most positive voltage peak within a 300-500 msec time window. P300 was scored by measuring the amplitude difference between N250 and P300.

Statistical Analysis

Analysis of the demographic and screening data was performed using the Statistical Package for the Social Sciences (SPSSx, 1983). Analyses of the ERP and performance data were conducted using SAS prcgrammes (Joyner, 1985). For the ERP search task data, four analyses of variance (ANOVAs) were completed. For each of the components, (N1 and P2) three Groups X two

Hemispheres (right vs. left) X two Stimulus Types (verbal vs. nonverbal) ANOVAs were carried out separately for central and parietal sites. For the performance data, an ANOVA (three Groups X two Stimulus Types) was conducted for each of the first four performance measures. For the hemispace errors, a Group X Hemispace (right vs. left) X stimulus type (verbal vs. nonverbal) for each type of error (omission and commission) ANOVA was performed.

For the SPEM tasks, an ANOVA was performed on the amplitude of P300 (relative to N250) for each bilateral pair of electrodes at central and parietal sites - 3 Groups X Task (Ignore vs. Press) X Direction (Right vs. Left) X Hemisphere. The amplitude of of P300 at Oz was also compared across tasks and for the direction of movement of the target (3 Groups X 2 Tasks X 2 Directions).

To ensure that the hand in which the subjects held the signal button was not relevant to P300 voltage in the three groups, supplementary 3 Groups X 2 Hands X Hemisphere X Direction ANOVAs were conducted for ERPs at central, parietal and occipital sites.

Results

Psychometric Measurements

A multivariate analysis of variance (MANOVA) was conducted to compare the groups on the 19 psychometric variables. These variables were: (1) physical anhedonia (ANPHYS), (2) social anhedonia (ANSOC), (3) perceptual abberation and magical ideation (PERMAG), (4) impulsive-non-conformity (NONCNF) (these are the four psychosis proneness scales), (5) depression (DEP), (6) hypomania (HYPOM), (7) biphasic mood (BIPH) (these are the three GBI subscales), (8) social assertiveness (SOCAS), (9) mood (MOOD), (10) cognitive and motor functioning (COGMOT), (11) sexual enhancement (SEXEN), (12) relaxation (RELX), (13) arousal (ARSL), (14) sleep (SLEEP) (these are the seven AEQ subscales), (15) total score on the AEQ (TOTAEQ), (16) quantity of alconol consumption per occasion (QUAN), (17) frequency of alcohol consumption (FREQ), (18) Michigan Alcoholism Screening Questionnaire (MAST) and (19) age.

The results of the MANOVA indicated that there was no overall significant difference among the three groups ($F(38,52)=1.01$, $p<.48$). Univariate F tests showed that the groups differed significantly on two of the 19 psychometric indices, but with such a high subject to variable ratio, the results must be accepted with

caution. The two differences were sexual enhancement on the AEQ ($F(2,44)=4.9$, $p<.05$), and depression on the GBI ($F(2,44)=3.6$, $p<.05$). On the depression subscale of the GBI, it appeared as if FR subjects were significantly more depressed than the other two groups but a Tukey test was not powerful enough to detect where group differences lay ($TSD(44)=13.8$, $p<.05$). Two of the 15 FR subjects had scores which exceeded the clinical depression cut-off score of 22 (Depue et al., 1985). A belief that sexual enhancement occurs with alcohol consumption also differentiated the groups, with the FR subjects believing more strongly than the Control group subjects ($TSD(44)=1.67$, $p<.01$). The PR group had a SEXEN score inbetween the other two groups, but they did not differ significantly from either group. No other variables differentiated the groups. See Tables 1a and 1b for a summary.

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insert Table 1 about here

Table 2 summarizes the correlations among the various psychopathology subscales (the four psychosis proneness scales, the MAC, the MAST, and the three affective disorder scales). It is evident that the MAC scale is not likely related to psychopathology in

Table 1a

Group Age and Drinking Measures Information

Group	N		AGE	MAC**	MAST	QUAN	FREQ	TOTAEQ	SEXEN*
1	15	M	19.1	17.8	0.400	4.20	3.47	22.9	3.07
		SD	(1.3)	(2.4)	(1.1)	(2.6)	(0.7)	(7.6)	(1.7)
2	17	M	20.6	26.9	1.29	6.59	3.41	25.8	4.18
		SD	(3.4)	(1.8)	(1.9)	(5.3)	(1.4)	(6.9)	(1.4)
3	15	M	20.5	20.2	1.67	6.27	3.47	25.6	4.80
		SD	(2.7)	(2.3)	(3.5)	(5.4)	(1.3)	(6.6)	(1.5)

* $p<0.05$
** $p<0.01$

Table 1b

Group Psychosis Proneness and Affective Disorder Scores

Group		ANPHYS	ANSOC	PERMAG	NONCNF	DEPR*	BIPH	HYPOM
1	M	25.3	14.8	20.1	20.2	68.7	11.5	36.9
	SD	(3.8)	(2.8)	(4.6)	(2.1)	(13.5)	(2.8)	(9.0)
2	M	23.3	14.0	21.9	20.6	68.3	11.5	38.8
	SD	(2.7)	(2.4)	(3.9)	(2.7)	(11.8)	(3.2)	(9.3)
3	M	24.8	14.9	21.1	21.0	82.0	13.4	39.4
	SD	(3.2)	(2.2)	(5.1)	(2.4)	(21.7)	(3.6)	(9.1)

* $p<0.05$

general as it does not correlate positively with these other indices of psychopathology. Instead, the MAC correlated negatively with physical anhedonia ($r=-0.40$, $p<.01$) suggesting that anhedonic individuals tend not to have the impulsive and hostile traits usually associated with problem drinking.

The MAST scale was found to correlate negatively with physical anhedonia, indicating that those who cannot experience as much physical pleasure as others are less likely to experience negative consequences of alcohol consumption. The MAST scale also correlated positively with depression and biphasic mood, suggesting that negative experiences stemming from drinking are more frequent in individuals who may be prone to mood disorders. The MAST did not correlate with any of the AEQ subscales. The MAST has been found to be a reliable indicator of problem drinking in a community survey, and was found to correlate positively with volume of drinking (Harburg et al., 1988). It also seems to be a reliable detector of problem drinking among psychiatric patients (Kaplan, Pokorny, Kanas, and Lively, 1974). In the present study, the MAST scale may have identified those experiencing problem drinking, but has not necessarily detected those with personalities associated

with risk for alcoholism. Thus, while it may be useful in confirming a diagnosis of alcoholism, the MAST appears to be rather insensitive to the presence of other psychometric or familial risk factors.

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insert Table 2 about here

Table 3 summarizes the correlations among the AEQ subscales and the total AEQ score. It is evident that one who believes that alcohol has positive effects on one of the measures tends to have positive expectancies about many effects of alcohol consumption. That the subscales intercorrelate significantly indicates that they are likely tapping similar beliefs about the positive expectancies of alcohol consumption. It is also evident that the SLEEP subscale is the least related to the other subscales, perhaps because it is comprised of only two items, limiting its reliability and discriminating power. Only the sexual enhancement subscale was related to FR and PR risk in this study, suggesting that expectancy measures may not be useful indicators of risk for alcoholism. In fact, Brown (1985) found that among non-problem drinkers, background variables such as family history of alcoholism and religion were better predictors of drinking patterns

Table 2

Correlations Among the Psychopathology Scales

	1 ANPHYS	2 ANSOC	3 PERMAG	4 NONCNF	5 MAC	6 MAST	7 DEP	8 HYPOM	9 BIPH
1	1.00	.07	-.23	.03	-.40**	-.37**	-.08	-.10	-.00
2		1.00	.18	.30*	-.21	.12	.04	-.01	.04
3			1.00	.21	.08	.22	.37**	.14	.28*
4				1.00	-.09	.10	.21	.09	.17
5					1.00	-.03	-.16	.00	-.16
6						1.00	.31*	.10	.26*
7							1.00	.50**	.74**
8								1.00	.72**

* $p<0.05$
** $p<0.01$

than expectancy measures. Only among heavy and problem drinkers were expectancy factors predictive of college drinking patterns. There were few if any problem drinkers among the subjects in this study. However, the more one drinks tends to be positively related the total score on the AEQ (Table 4).

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insert Tables 3 about here

A summary of the inter-relationships among the drinking-related personality and behaviour scales is presented in Table 4. The MAC correlated with none of the measures perhaps because few, if any, of the subjects in this study were problem drinkers. The MAC tends to detect alcoholics well, but does detect some false positives too (Davis et al., 1987). The MAC scale may be detecting those with personality characteristics related to alcoholism, but not necessarily those who drink heavily, have experienced problems with drinking, or who expect that alcohol consumption improves general well-being. It has been found to predict who will become an alcoholic (Saunders and Schuckit, 1981), so perhaps in time PR subjects will develop other signs of problem-drinking. The MAST scale correlates positively with only

Table 3

Correlations of the Alcohol Expectancy Questionnaire

	1 SOCAS	2 MOOD	3 COGMOT	4 SEXEN	5 RELX	6 ARSL	7 SLEEP	8 TOTAEQ
1	1.00	0.57**	0.46**	0.35**	0.66**	0.54**	0.30*	0.83**
2		1.00	0.35**	0.32*	0.55**	0.42**	0.14	0.68**
3			1.00	0.28*	0.47**	0.42**	-0.01	0.66**
4				1.00	0.26*	0.36**	0.04	0.59**
5					1.00	0.49**	0.25*	0.80**
6						1.00	0.23	0.71**
7							1.00	0.35**

* $p<0.05$
** $p<0.01$

quantity of alcohol consumption, suggesting that those who drink more per occasion may encounter more drinking related problems. No other drinking-related measures correlated with MAST, perhaps because scores tended to be extremely low except for one Family risk subject, curtailing the range of scores available for correlations. Correlational analyses also indicated that quantity of alcoholism consumed per occasion correlated positively with depression ($r=0.29$, $p<.05$), hypomania ($r=0.28$, $p<.05$) and biphasic mood ($r=0.40$, $p<.01$), and frequency of consumption correlated positively with depression ($r=0.27$, $p<.05$), suggesting that those who drink more heavily are more likely to be prone to mood disturbances.

---

insert Table 4 about here

Visuospatial performance

A Group X Task ANOVA was performed on each dependent measure. The Non-verbal task took longer (total search time: $F(1,36)=28.9$, $p<.001$). It was also performed less systematically, where a lower score means a more efficient search. (Mean search score: $F(1,36)=17.7$, $p<.001$). Fewer targets were detected

Table 4

Correlations Among Drinking Measures

	1 QUAN	2 FREQ	3 MAC	4 MAST	5 TOTAEQ
1	1.00	0.37**	0.12	0.26*	0.60**
2		1.00	0.06	-0.12	0.53**
3			1.00	-0.03	0.17
4				1.00	0.08

* $p<0.05$
** $p<0.01$

($F(1,36)=11.37$, $p<.01$) and more errors of commission were made in the non-verbal task ($F(1,36)=2.9$, $p<.10$), but only the former reached significance.

The FR subjects performed the task the most slowly, and the PR group the fastest, but group differences did not reach statistical significance (total search time: $F(2,36)=2.45$, $p<.10$). There were no group differences in number of commission errors (cancelling a non-target item) or omission errors (neglecting to cancel a target). Mean search score also did not differentiate the groups, indicating that the three groups were approximately as efficient or systematic in completing the tasks. However, Figs 1a,b and 2a,b show that, overall, the FR group tended to perform the worst in all performance measures. The PR group tended to be the fastest, but made more errors than the Control subjects.

---

insert Figures 1a, 1b, 2a, and 2b about here

Although most of the visual search performance measures did not differentiate the groups, a 3 Groups X Stimulus Type (verbal vs. nonverbal) X Hemispace (right vs. left) ANOVA, with errors of omission as the

Figure Caption

Figure 1a. Total search time for verbal and nonverbal targets: A comparison of the three groups

Figure 1b. Mean search score for verbal and nonverbal targets: A comparison of the three groups

Fig. 1a
TOTAL SEARCH TIME

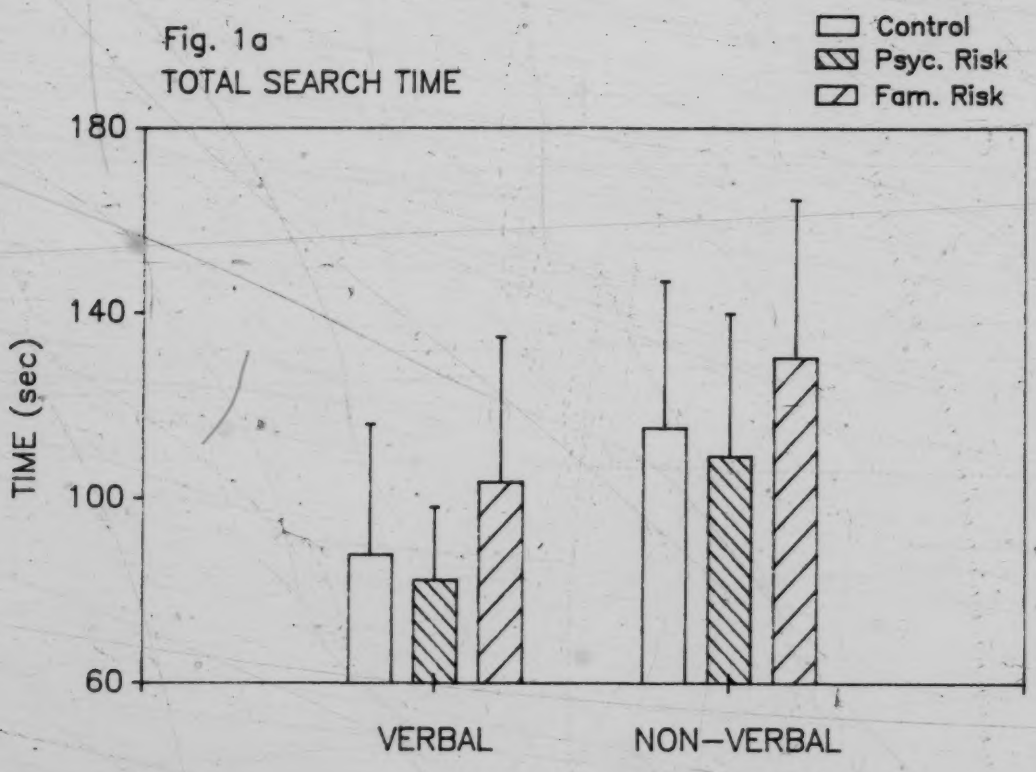


Fig. 1b
MEAN SEARCH SCORE

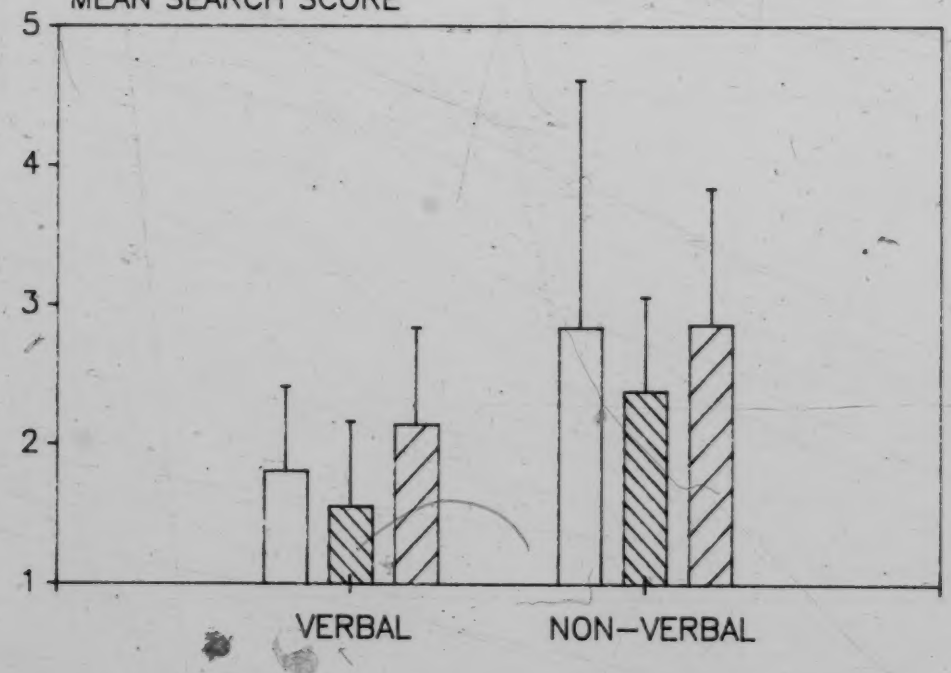


Figure Caption

Figure 2a. Correct number of targets detected in verbal and nonverbal visual search: A comparison of the three groups

Figure 2b. Errors of commission during verbal and nonverbal visual search: A comparison of the three groups

Fig. 2a
CORRECT TARGETS DETECTED

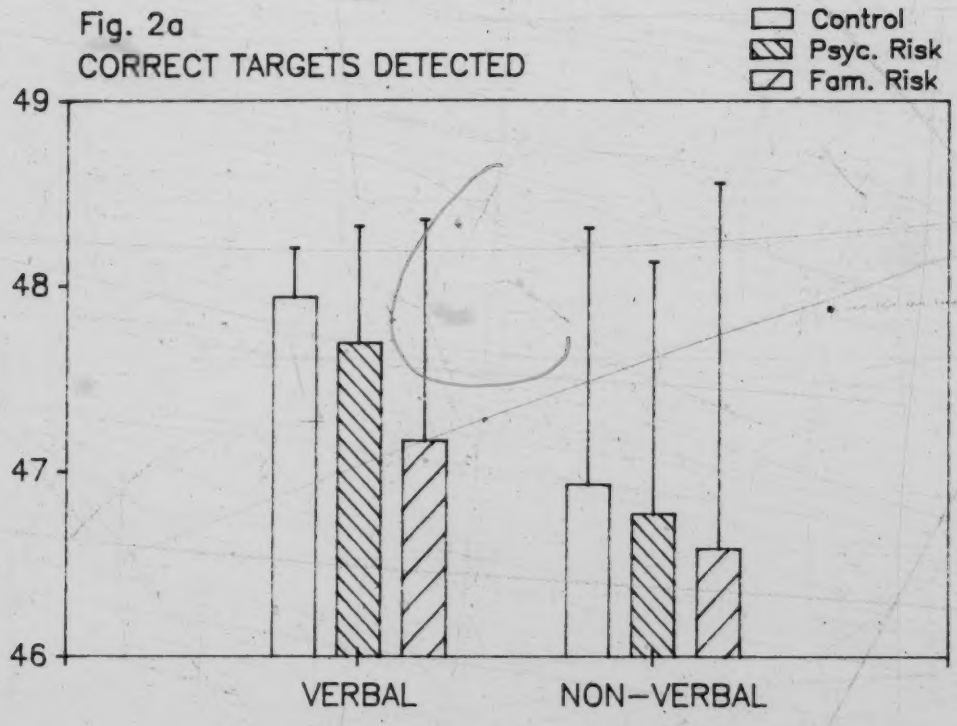
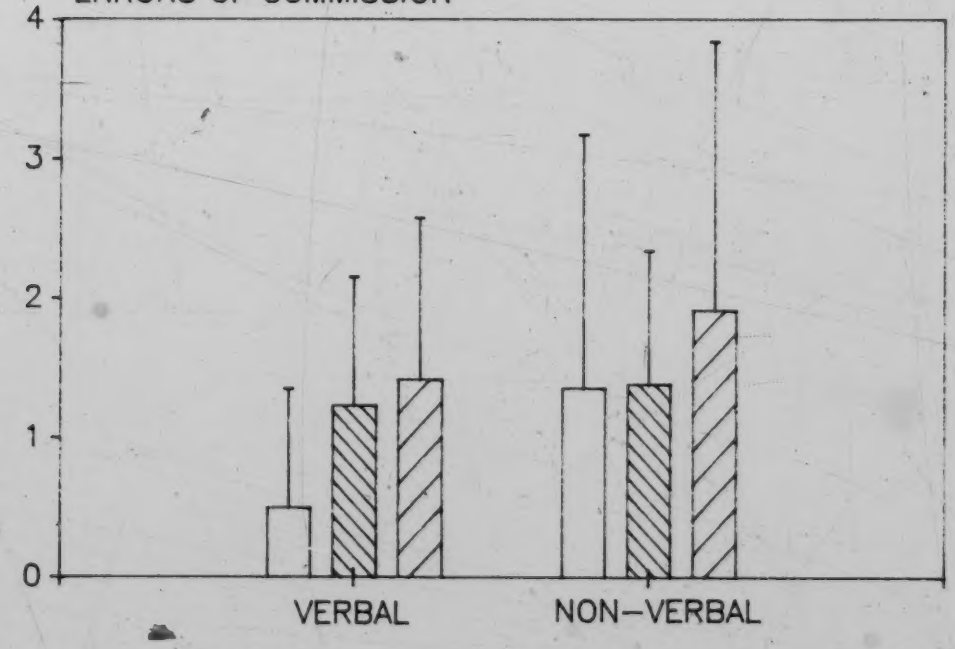


Fig. 2b
ERRORS OF COMMISSION



dependent variable, yielded interesting group differences. A similar ANOVA, using errors of commission as the dependent variable, did not demonstrate group differences.

For errors of omission, there was a significant main effect for Stimulus Type, whereby fewer targets were detected for the nonverbal Search task (see above). Also, a significant main effect for Hemispace was found ($F(1,36)=6.66$, $p<.05$): fewer right sided targets were detected. A significant Hemispace X Stimulus Type interaction occurred ($F(1,36)=4.41$, $p<.05$), such that there was a greater difference for right- and left-sided errors for the nonverbal task. Tukey tests showed that there were more right-sided errors than left for both types of tasks, and more nonverbal errors than verbal for both left and right sides of the random displays ($TSD(36)=0.38$, $p<.01$). This suggests that it was most difficult for the subjects to detect right-sided nonverbal targets. As will be shown below, this significant interaction can essentially be accounted for by the performance of the risk groups.

A statistically significant Group X Hemispace X Stimulus Type interaction was found ($F(2,36)=4.82$, $p<.05$). It appears, that on the verbal Search task, the

groups did not differ on rate of left- and right-sided omission errors (Fig. 2c). However, on the nonverbal Search task, there was a striking difference between the Control group and the two risk groups. Specifically, the two risk groups had virtually no left-sided omission errors and a high rate of errors on the right side. The Control group, on the other hand, made slightly more errors in the left hemispace than the right (Fig. 2d). These group differences were confirmed by Tukey tests. There were no group differences for either left- or right-sided errors during the verbal Search task, nor for left-sided errors during the nonverbal Search task. For the nonverbal task, there was a significant group difference for the right-sided omission errors, such that both risk groups produced more errors than the Control subjects, but PR and FR subjects did not differ from each other ($TSD(36)=0.726$, $p<.01$).

---

insert Figures 2c and 2d about here

In order to be certain that the overall rate of errors did not distort ANOVA results, a supplementary ANOVA was conducted in which asymmetry was analyzed independently of rate of errors for the groups. An "asymmetry index" was calculated by subtracting left-

Figure Caption

Figure 2c. Verbal search errors of omission: A comparison of left- and right-hemispace error rates for each group

Figure 2d. Nonverbal search errors of omission: A comparison of left- and right-hemispace error rates for each group

Figure 2c: Verbal Search Errors

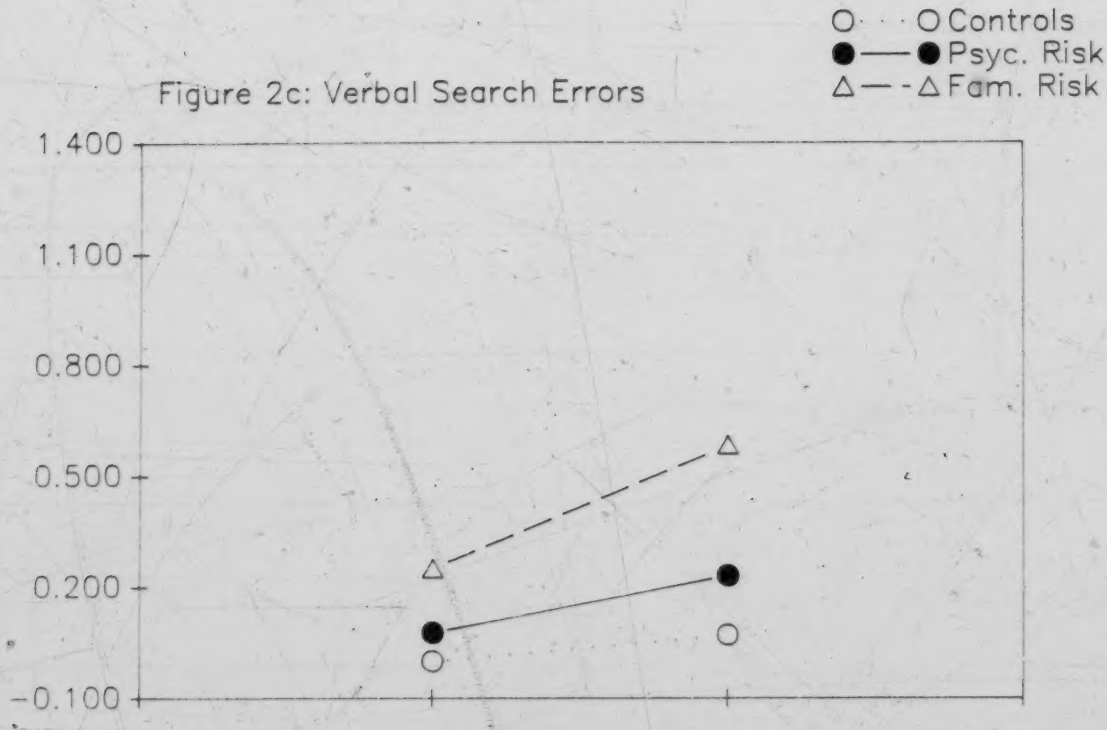
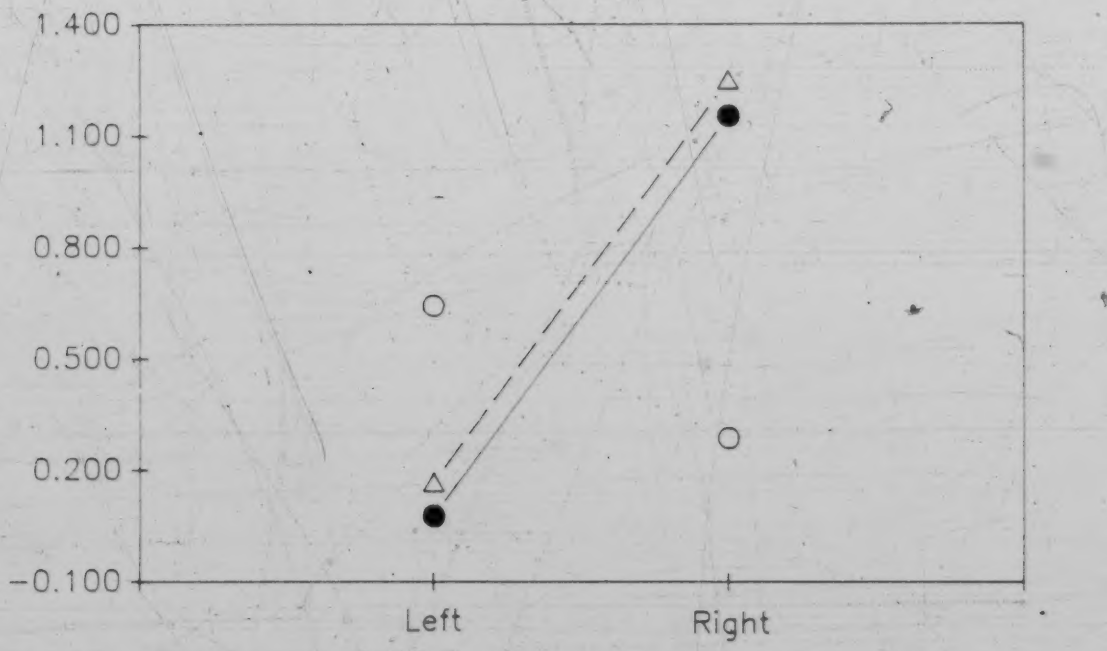


Figure 2d: Nonverbal Search Errors



from right-sided errors and then dividing by the total number of errors for each subject. (Note that a +1 was added to each person's error score, because some made no errors, and it is impossible to divide by zero). Therefore, a positive asymmetry index indicates that more right-sided errors were made, and a negative asymmetry index means that more left-sided errors were made. A Groups X Stimulus Types (verbal vs. nonverbal) ANOVA was conducted with the asymmetry index as the dependent measure. There was a significant main effect of Group ($F(2,36)=4.24$, $p<.05$) such that the PR subjects demonstrated the greatest number of right-sided errors relative to the total, and Control subjects the least. There was also a significant Stimulus Type X Group interaction ($F(2,36)=5.66$, $p<.01$). On the verbal task, there was little difference in asymmetry of errors among the groups. However, on the nonverbal Search task, there was a significant difference. A Tukey test confirmed that both risk groups omitted more right-sided targets relative to the total number of omissions than the Control group ($TSD(36)=0.222$, $p<.01$). See Fig. 2e.

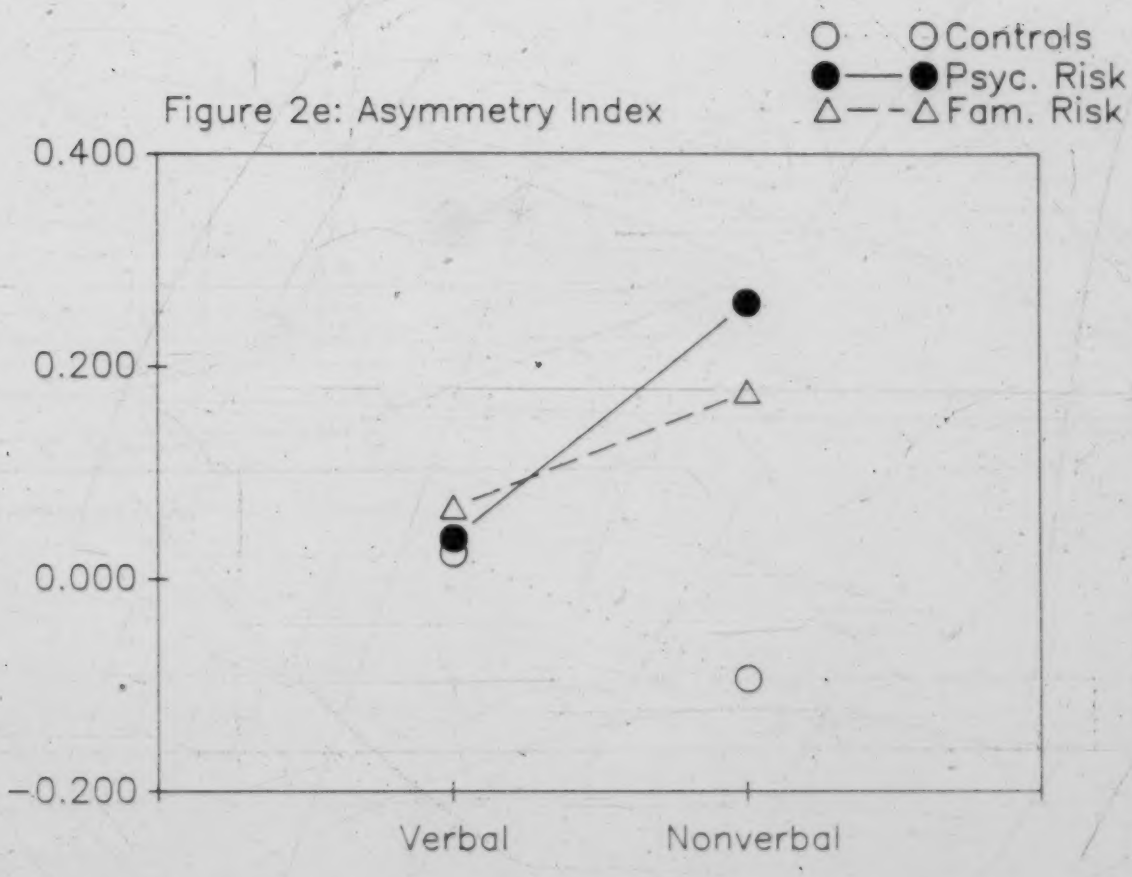
---

insert Figure 2e about here

Figure Caption

Figure 2e. A comparison of the verbal and nonverbal asymmetry index for each group showing that risk groups made more right-sided errors during nonverbal search task than the Controls

Figure 2e: Asymmetry Index



Event-related potentials

Separate Group X Hemisphere X Task ANOVAs were performed on N1 and P2 amplitudes recorded from parietal and central sites. There was a significant main effect of Hemisphere ($F(1,36)=7.75$, $p<.01$) for N1 recorded parietally. Fig. 3 depicts averaged ERPs for Group 1, where it can be seen (Fig. 3b) that ERPs recorded to probe tones over the left hemisphere were marked by a negative shift, especially during visual search (Verbal (VR) and Non-verbal (NR)). That is, it appeared that the right parietal region was less responsive to the probes than the left, consistent with our expectation that the right hemisphere would be more involved in visual search. A subsequent ANOVA on N1 amplitude during the baseline (Warmup) task revealed no significant Hemisphere effect.

---

insert Figure 3 about here

For P2 amplitude recorded from central sites, there was a significant Group X Hemisphere X Task interaction ($F(2,72)=3.29$, $p<.02$) which is shown in Fig. 4. The largest differences between search tasks and baseline task for control subjects were recorded over

Figure Caption

Figure 3. Averaged ERPs for Control subjects for the Warmup and Search tasks at central (C3 and C4) and parietal (P3 and P4) sites showing N1 and P2 peaks

Figure 3a

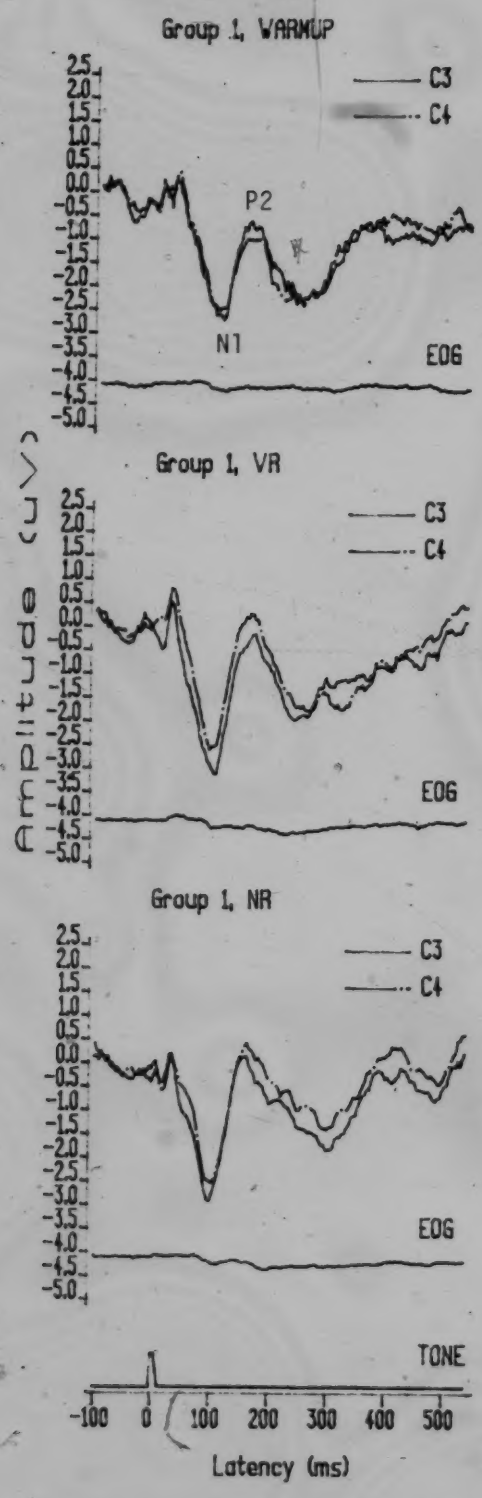
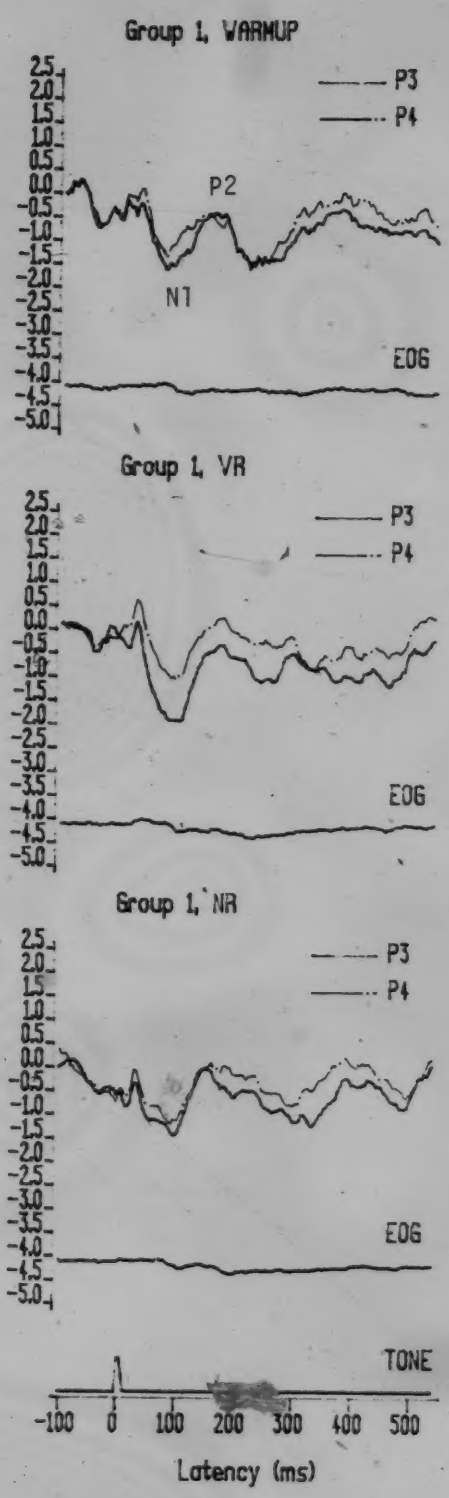


Figure 3b



the right hemisphere. The risk groups were abnormal in this regard, particularly during search of the verbal array. These group differences were readily apparent in the averaged ERPs (Figs 5a,b,c). Tukey Significance Difference tests were performed to determine where group differences lay. It was evident that at C4, the Control group had larger P2 amplitudes than the PR and FR subjects ($TSD(72)=0.68$, $p<.01$) during the verbal search task, and that the FR group had larger P2 amplitudes than the Controls during WARMUP. Recall that increased P2 amplitudes indicates less attentional involvement of that hemisphere in the task, suggesting that the Controls had appropriate right hemisphere activity: low during the primarily perceptual-motor WARMUP task relative to the FR group, and more right hemisphere involvement in the verbal search task relative to the two risk groups. Thus, the risk groups had abnormally large responses to the tone probes at right hemisphere sites during the search of a verbal array suggesting that either they had insufficient resources available for the task or they could not efficiently allocate resources away from irrelevant probes to the primary task.

---

insert Figures 4 and 5 about here

Though not statistically significant, similar findings were observed in the parietal recordings (Figs. 6, and 7a,b,c). The most striking anomally was the absence of a normal attenuation of post-N1 negativity in the right-sided ERPs of the risk groups during search of the verbal array relative to the baseline task.

---

insert Figures 6 and 7 about here

The SPEM task: N250-P300 Amplitude Difference:

Four-way ANOVAs (Group X Hemisphere X Condition X Direction) were conducted with Group as the between subject variable, and P300 amplitude the dependent variable. Condition refers to the Ignore and Press versions of the SPEM task, and Direction refers to the direction of target movement (to the left or the right). Separate ANOVAs were carried out for P300s at central, parietal and occipital sites. At central sites it was evident that there was a main effect for Hemisphere ($F(1,38)=1.86$, $p<.05$). P300 amplitudes were larger in the right hemisphere, suggesting more right hemisphere

Figure Caption

Figure 4. P2 amplitude compared at left (C3) and right (C4) central sites for the Warmup and two Search tasks

Figure 4

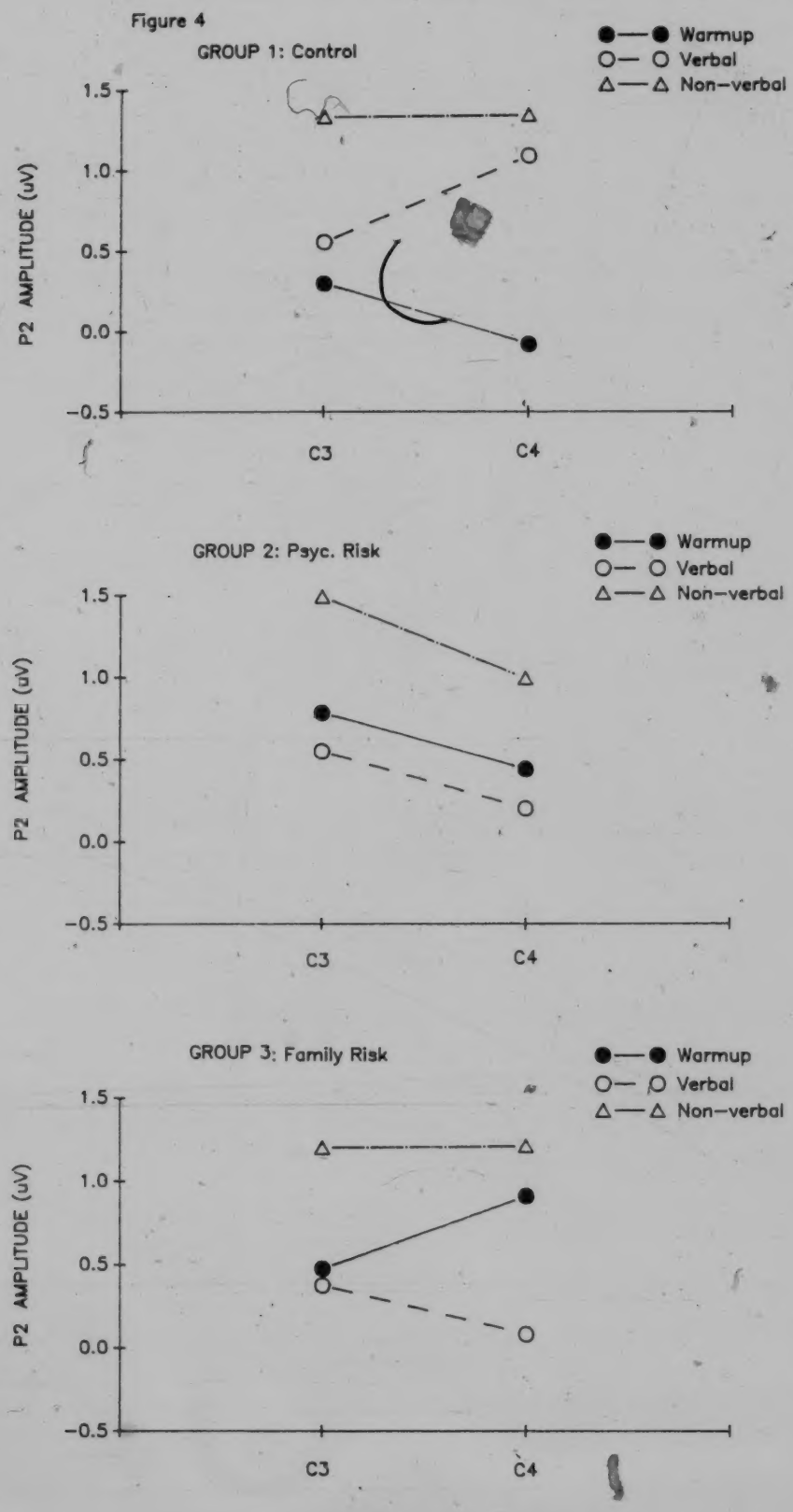

GROUP 1: Control
Warmup
Verbal
Non-verbal
P2 AMPLITUDE (uV)
1.5
1.0
0.5
0.0
-0.5
C3
C4
GROUP 2: Psyc. Risk
Warmup
Verbal
Non-verbal
P2 AMPLITUDE (uV)
1.5
1.0
0.5
0.0
-0.5
C3
C4
GROUP 3: Family Risk
Warmup
Verbal
Non-verbal
P2 AMPLITUDE (uV)
1.5
1.0
0.5
0.0
-0.5
C3
C4

Figure Caption

Figure 5a. Comparison between Warmup and visual Search task ERPs for the Control subjects (central sites) showing N1 and P2 peaks

Figure 5b. Comparison between Warmup and visual Search task ERPs for the Psychometric risk subjects (central sites) showing N1 and P2 peaks

Figure 5c. Comparison between Warmup and visual Search task ERPs for the Family risk subjects (central sites) showing N1 and P2 peaks

Figure 5a

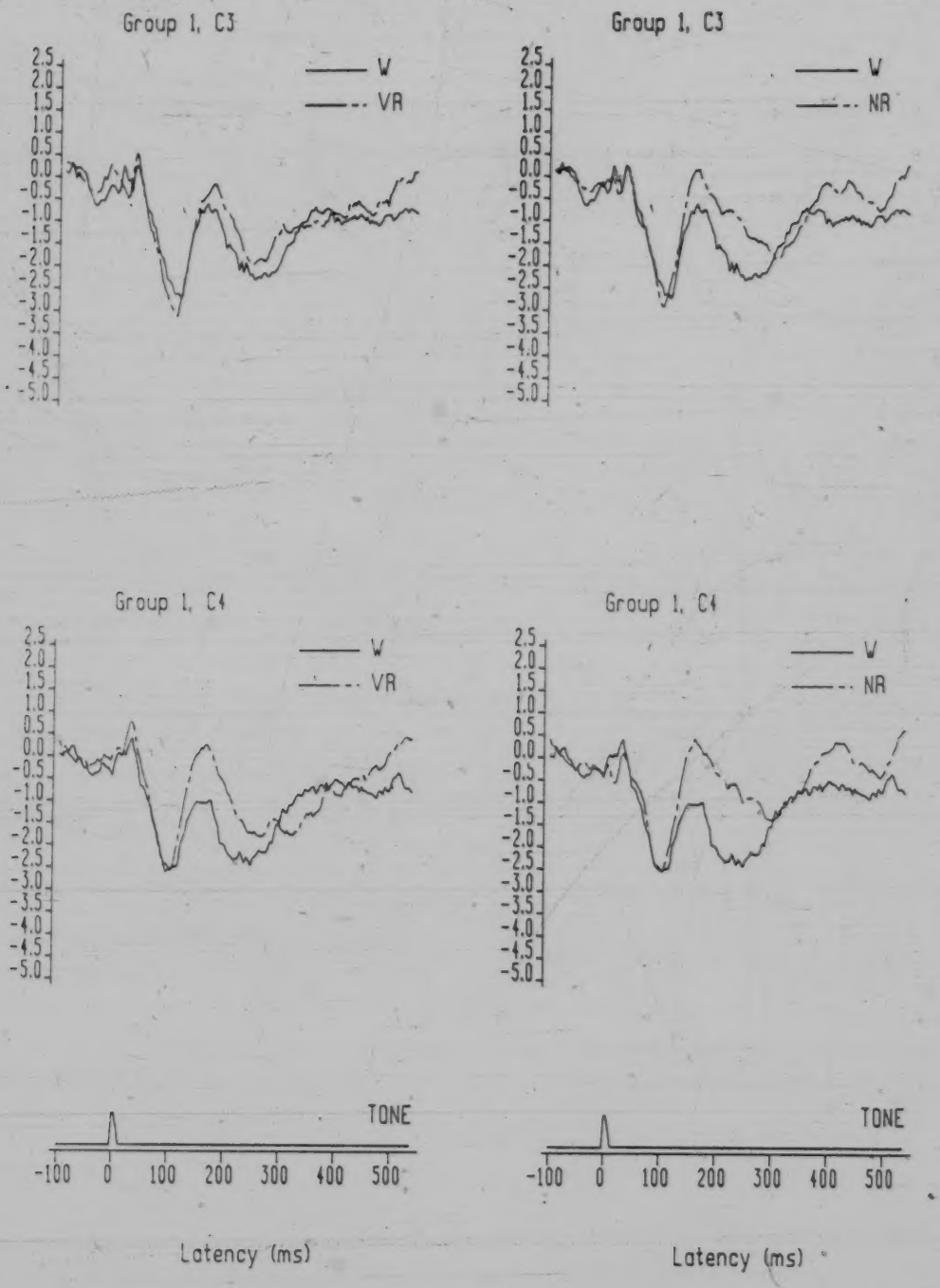

Group 1, C3
W
VR
Group 1, C3
W
NR
Group 1, C4
W
VR
Group 1, C4
W
NR
Amplitude (uV)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
TONE
-100
0
100
200
300
400
500
Latency (ms)
Latency (ms)

Figure 5b

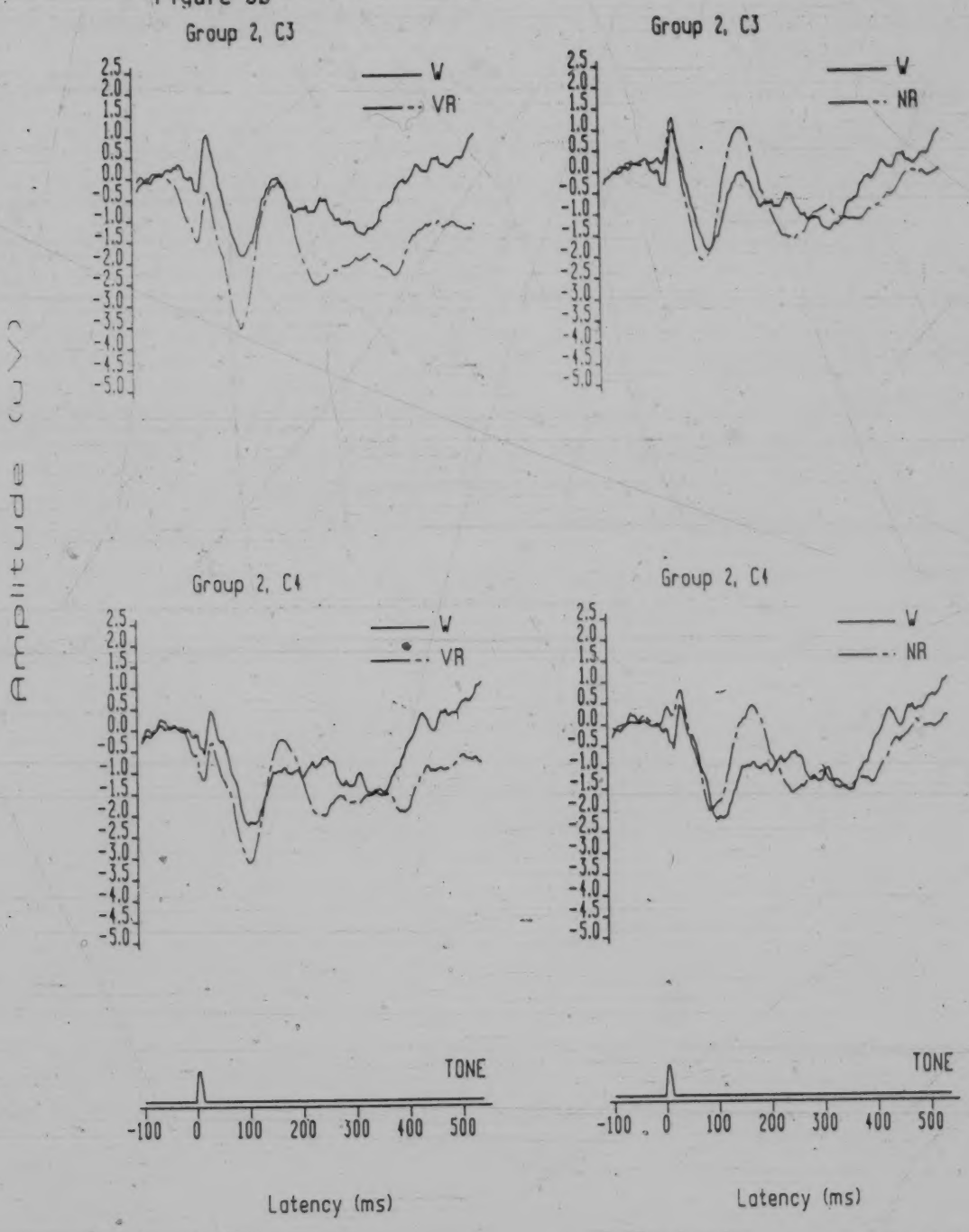

Group 2, C3
V
VR
Group 2, C3
V
NR
Group 2, C4
V
VR
Group 2, C4
V
NR
Amplitude (uV)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
TONE
-100
0
100
200
300
400
500
Latency (ms)

Figure 5c

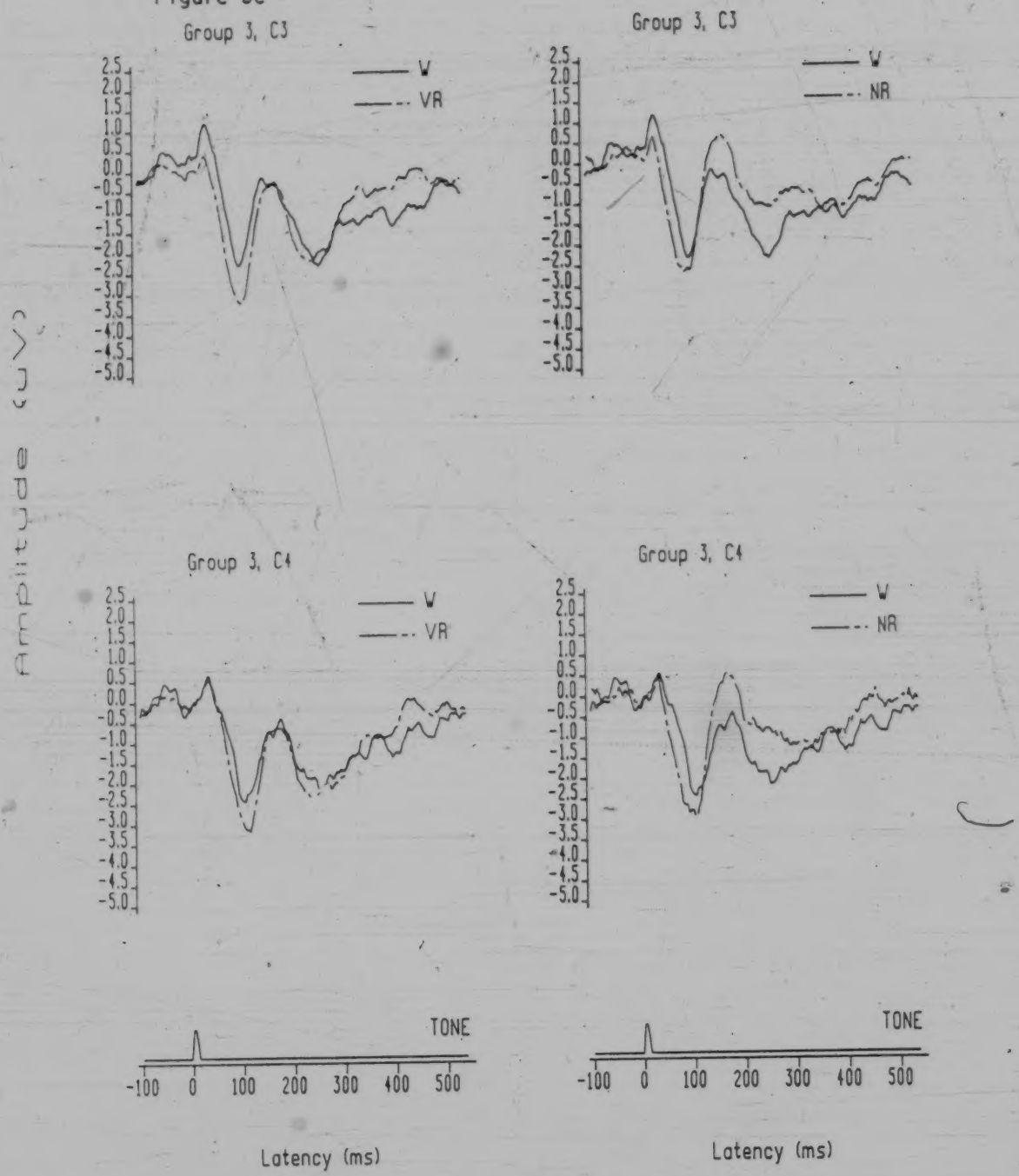

Group 3, C3
W
VR
Group 3, C3
W
NR
Group 3, C4
W
VR
Group 3, C4
W
NR
Amplitude (uV)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
TONE
-100
0
100
200
300
400
500
Latency (ms)

Figure Caption

Figure 6. P2 amplitude compared at left (P3) and right (P4) parietal sites for the Warmup and two Search tasks

Figure 6

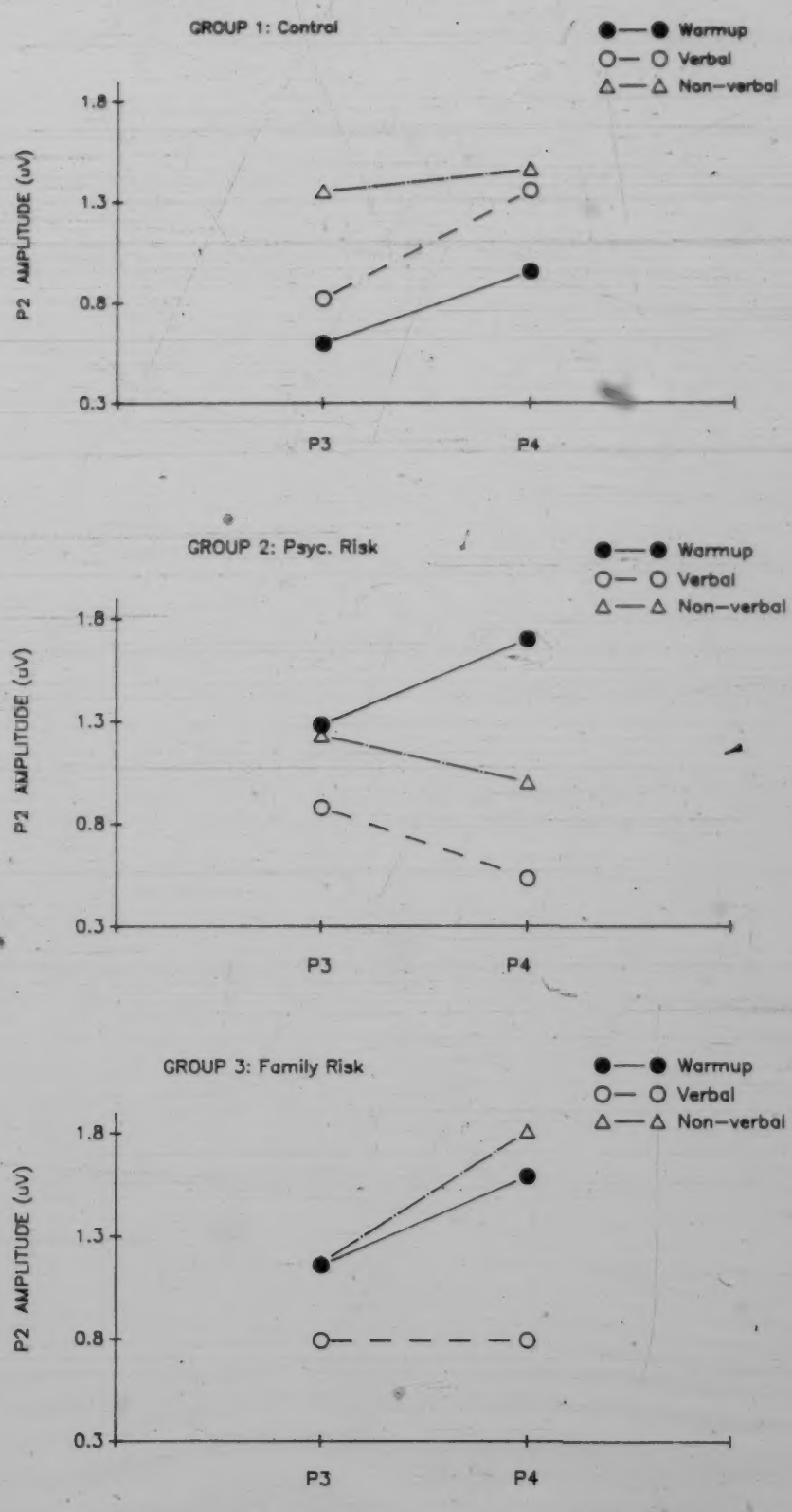

GROUP 1: Control
Warmup
Verbal
Non-verbal
P2 AMPLITUDE (uV)
1.8
1.3
0.8
0.3
P3
P4
GROUP 2: Psyc. Risk
Warmup
Verbal
Non-verbal
P2 AMPLITUDE (uV)
1.8
1.3
0.8
0.3
P3
P4
GROUP 3: Family Risk
Warmup
Verbal
Non-verbal
P2 AMPLITUDE (uV)
1.8
1.3
0.8
0.3
P3
P4

Figure Caption

Figure 7a. Comparison between Warmup and visual Search task ERPs for the Control subjects (parietal sites) showing N1 and P2 sites

Figure 7b. Comparison between Warmup and visual Search task ERPs for the Psychometric risk subjects (parietal sites) showing N1 and P2 sites

Figure 7c. Comparison between Warmup and visual Search task ERPs for the Family risk subjects (parietal sites) showing N1 and P2 sites

Figure 7a

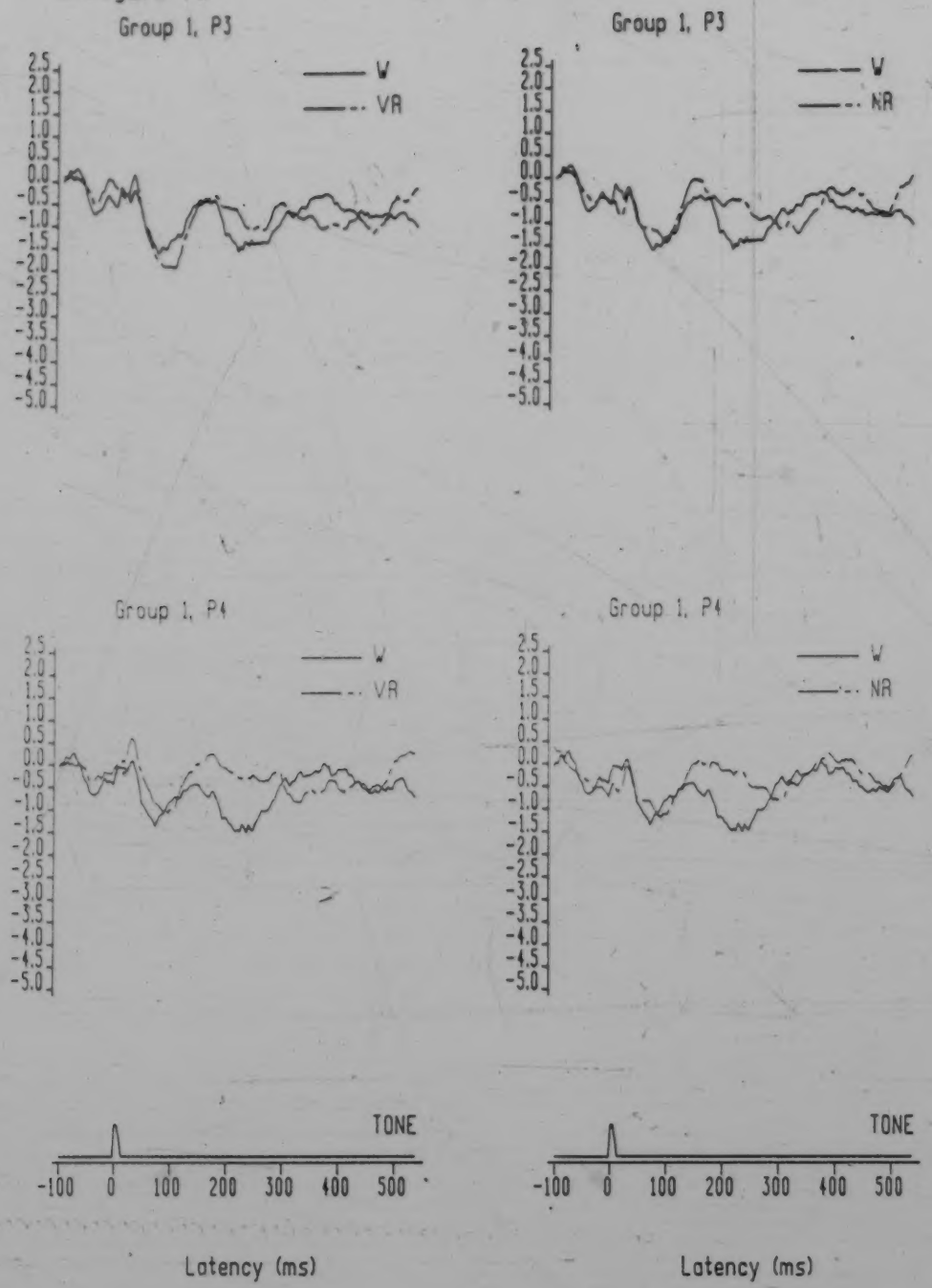

Group 1, P3
W
VR
Group 1, P3
W
NR
Group 1, P4
W
VR
Group 1, P4
W
NR
Amplitude (uV)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
TONE
-100
0
100
200
300
400
500
Latency (ms)

Figure 7b

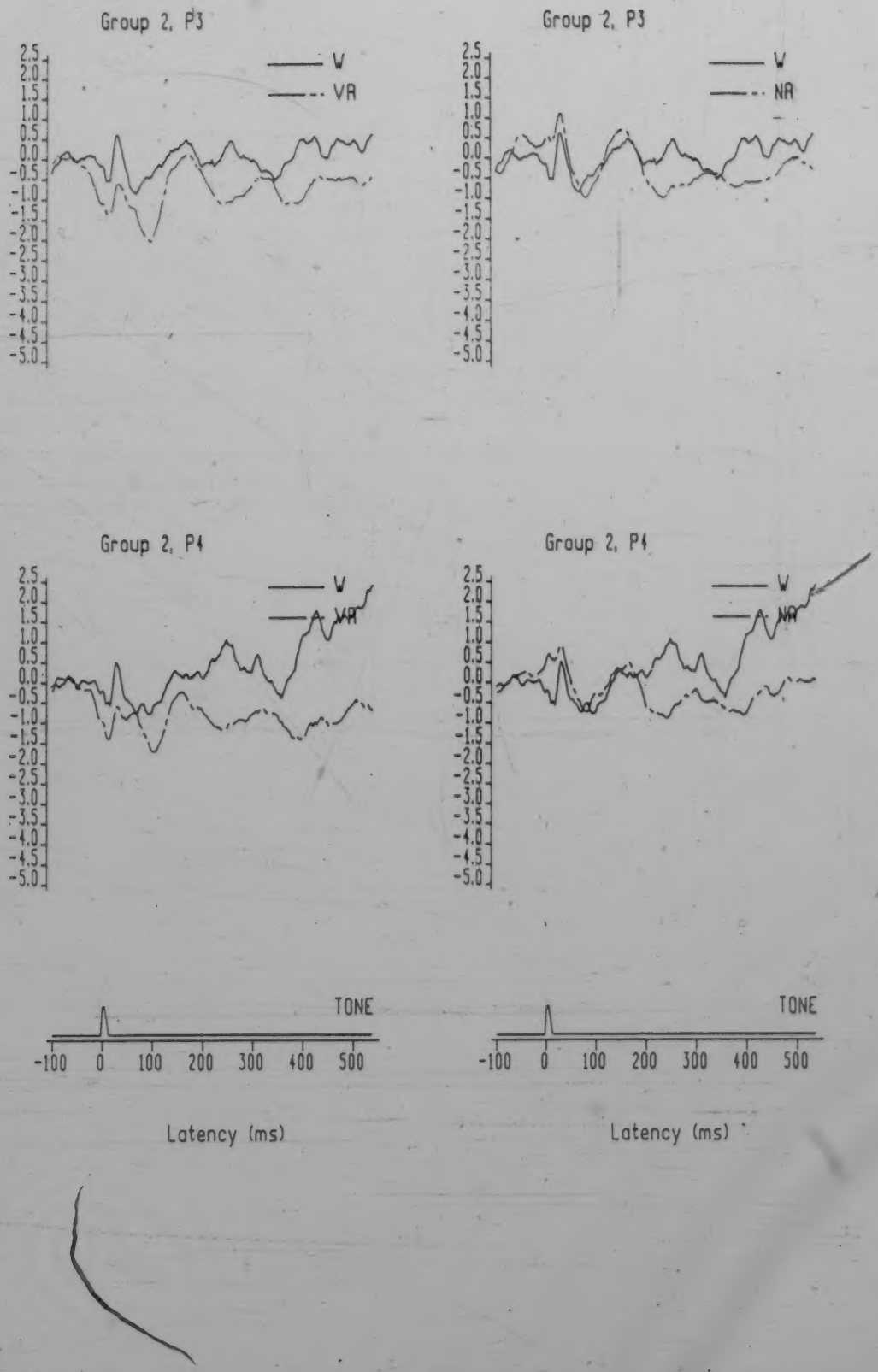
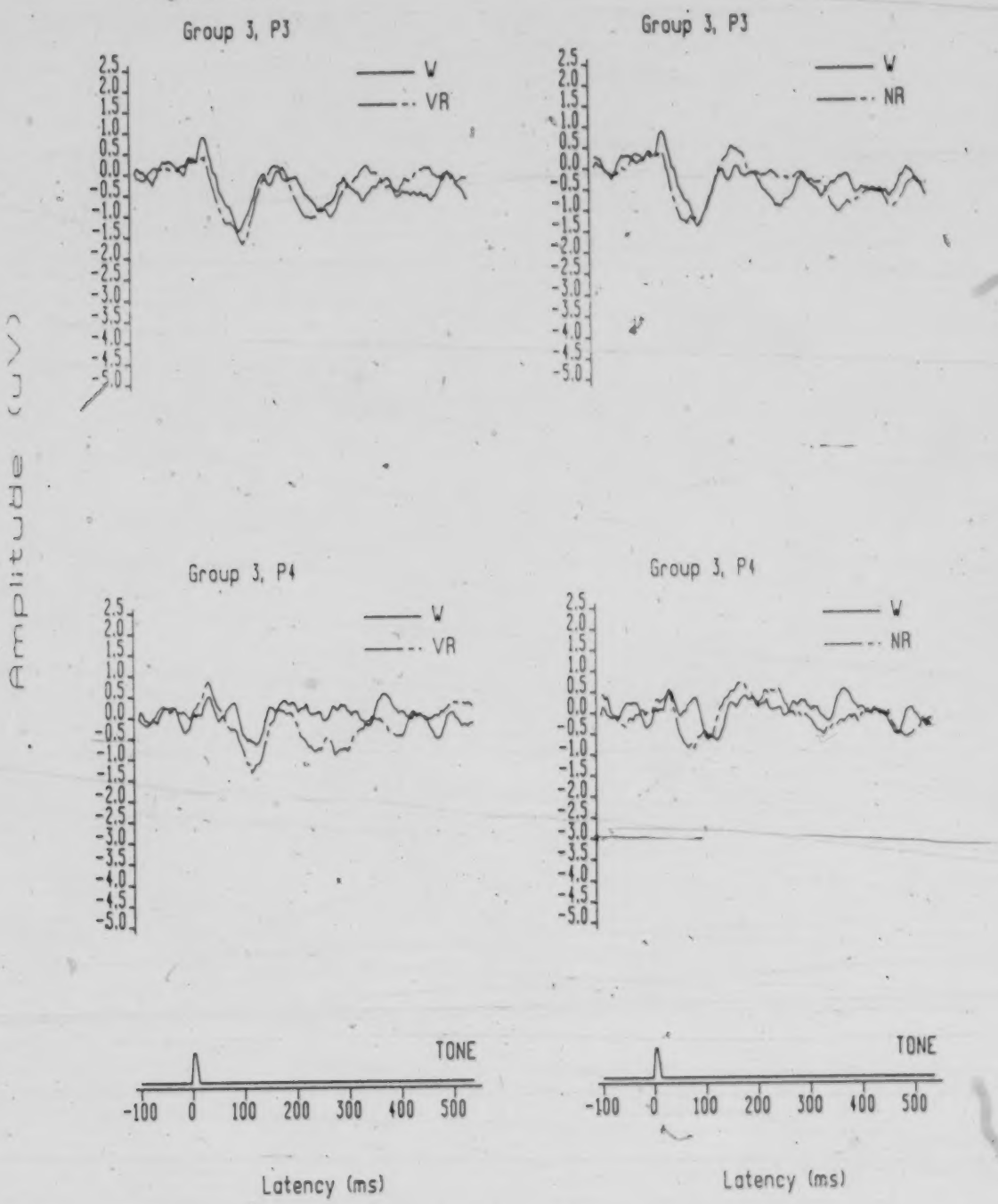

Group 2, P3
W
VR
Group 2, P3
W
NR
Amplitude (uV)
Group 2, P4
W
VR
Group 2, P4
W
NR
TONE
-100 0 100 200 300 400 500
Latency (ms)
TONE
-100 0 100 200 300 400 500
Latency (ms)

Figure 7c


Group 3, P3
V
VR
Group 3, P3
V
NR
Amplitude (uV)
Group 3, P4
V
VR
Group 3, P4
V
NR
TONE
-100 0 100 200 300 400 500
Latency (ms)
TONE
-100 0 100 200 300 400 500
Latency (ms)

involvement in the tracking task in general. However, as will be described below, this right hemisphere increased activity is likely due to hyperresponsivity in the risk subjects, as suggested by significant Group X Direction and Group X Hemisphere X Condition interactions. There was also a main effect of Condition ($F(1,38)=65.14$, $p<.001$), such that the Press condition elicited greater P300 amplitudes, likely due to increased attentional load. This is evident by comparing Figures 8 and 9.

There were also several significant interactions at central sites. Direction X Hemishere was significant ($F(1,38)=97.9$, $p<.001$) indicating that when the target was moving right, P300s were larger in the right hemisphere relative to the left. Likewise, when the target was moving left, P300s in the left were significantly larger in the left relative to the right. Note the illustration of this pattern for the Ignore condition (Figure 8) and Press condition (Figure 9). Hemisphere X Condition was significant ($F(1,38)=5.54$, $p<.05$), suggesting that while there was almost no difference between the P300 peaks at C3 and C4 during Ignore, the P300 peaks recorded over C4 during Press were larger than at C3. This may indicate that greater right hemisphere attentional or cognitive resources were

involved in the Press condition of the SPEM task. However, these findings are likely due to hyperresponsivity of the right hemisphere in the risk groups (see below).

---

insert Figures 8 and 9 about here

There was a modest but significant Group X Direction interaction ($F(2,38)=3.58$, $p<.05$) at central sites (Fig. 10a). This is difficult to interpret as there is no literature to suggest what is considered "normal". However, it appears that the three groups differed from each other in terms of the size of P300 amplitude depending on whether the target was moving left or right. Pairwise comparisons showed that when the target was moving right, thus engaging more right hemisphere resources, all three groups differed from each other, the two risk groups exhibiting hemispheric hyperarousal relative to the controls, and the FR subjects having the largest P300 peaks ($TSD(38)=2.55$, $p<.01$). When the target was moving to the left, both risk groups exhibited greater P300 peaks than the Control subjects ($p<.01$).

Figure Caption

Figure 8a. P300 for the Ignore version of the SPEM task comparing responses over left and right central, parietal and occipital sites: Control subjects

Figure 8b. P300 for the Ignore version of the SPEM task comparing responses over left and right central, parietal and occipital sites: PR subjects

Figure 8c. P300 for the Ignore version of the SPEM task comparing responses over left and right central, parietal and occipital sites: FR subjects

Figure 8a

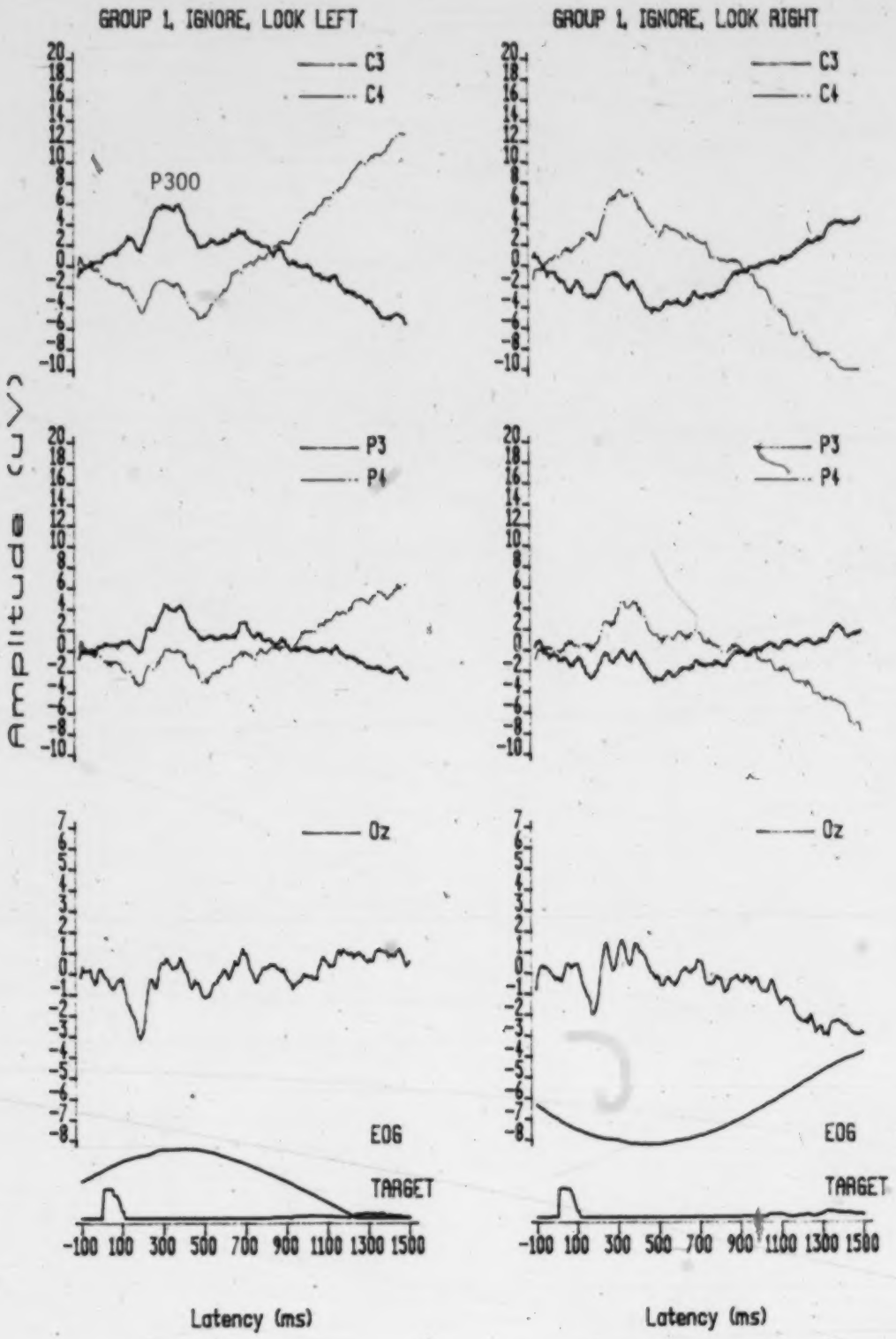

GROUP 1, IGNORE, LOOK LEFT
GROUP 1, IGNORE, LOOK RIGHT
C3
C4
P300
P3
P4
Oz
EOG
TARGET
Amplitude (uV)
-100 100 300 500 700 900 1100 1300 1500
Latency (ms)

Figure 8b

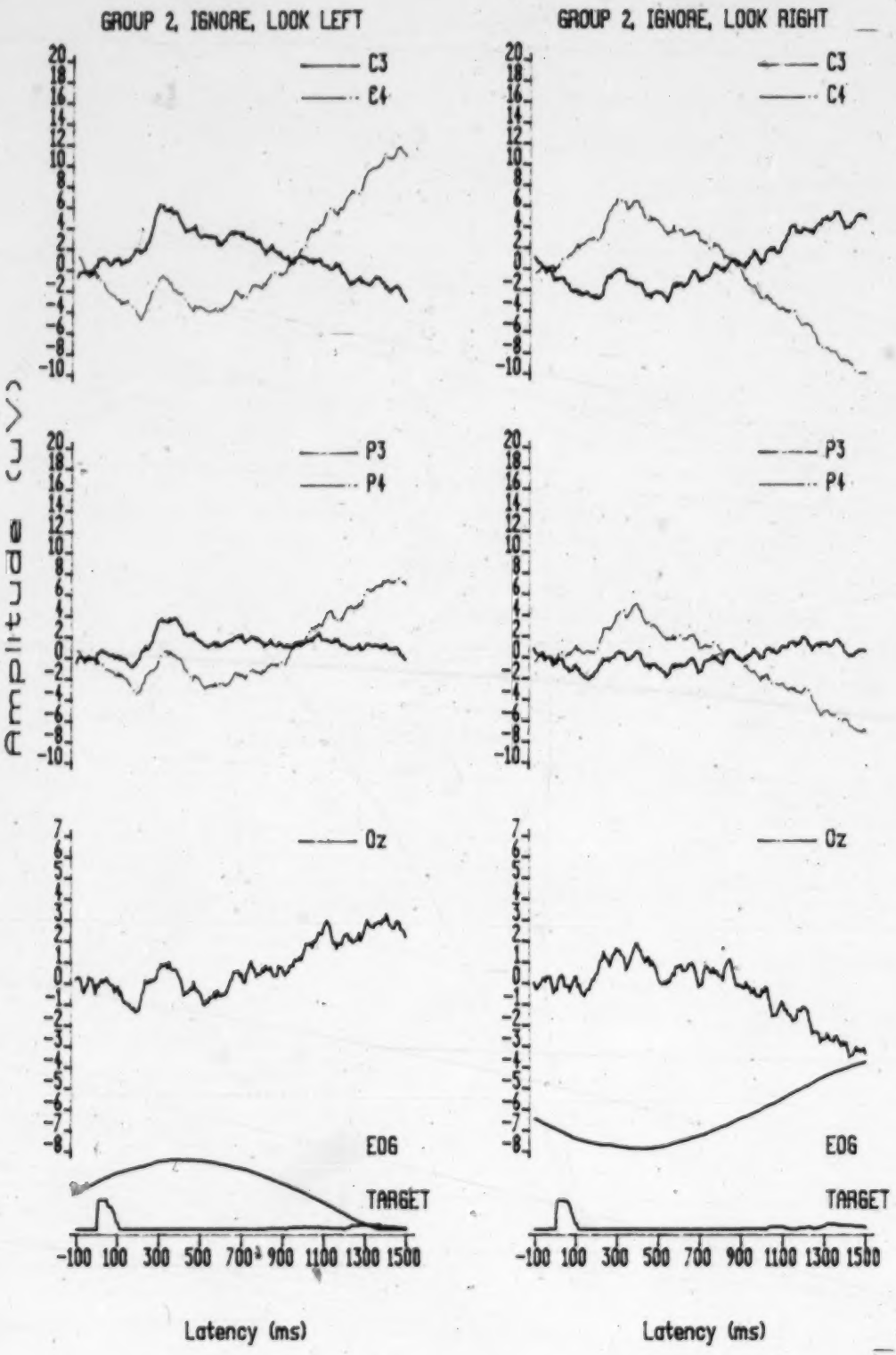

GROUP 2, IGNORE, LOOK LEFT
GROUP 2, IGNORE, LOOK RIGHT
C3
C4
P3
P4
Oz
EOG
TARGET
Amplitude (uV)
-100 100 300 500 700 900 1100 1300 1500
Latency (ms)

Figure 8c

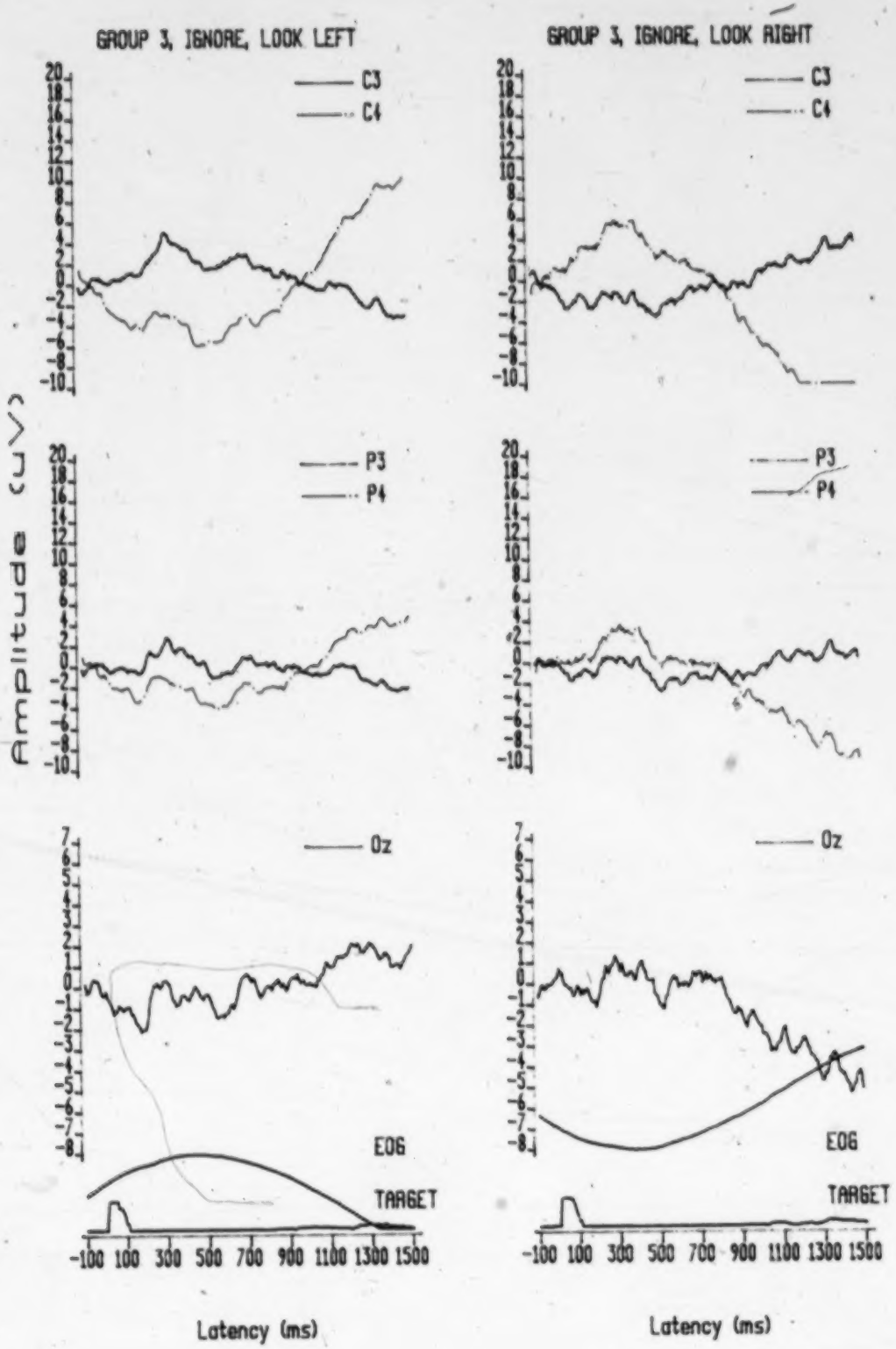

GROUP 3, IGNORE, LOOK LEFT
GROUP 3, IGNORE, LOOK RIGHT
C3
C4
P3
P4
Oz
EOG
TARGET
Amplitude (uV)
-100 100 300 500 700 900 1100 1300 1500
Latency (ms)

Figure Caption

Figure 9a. P300 for the Press version of the SPEM task comparing responses over left and right central, parietal and occipital sites: Control subjects

Figure 9b. P300 for the Press version of the SPEM task comparing responses over left and right central, parietal and occipital sites: PR subjects

Figure 9c. P300 for the Press version of the SPEM task comparing responses over left and right central, parietal and occipital sites: FR subjects

Figure 9a

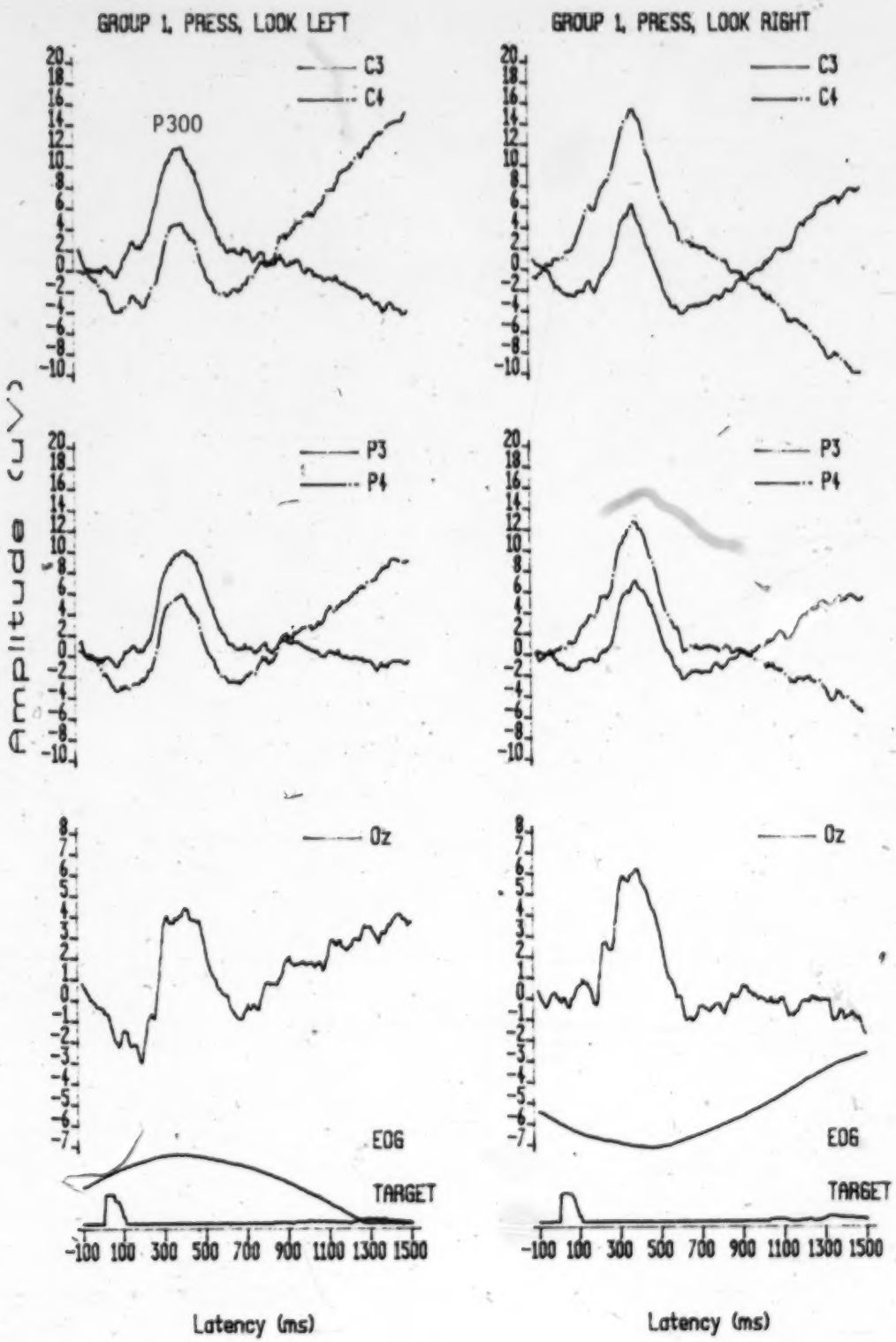

GROUP 1, PRESS, LOOK LEFT
GROUP 1, PRESS, LOOK RIGHT
C3
C4
P300
P3
P4
Oz
EOG
TARGET
Amplitude (uV)
-100 100 300 500 700 900 1100 1300 1500
Latency (ms)

Figure 9b

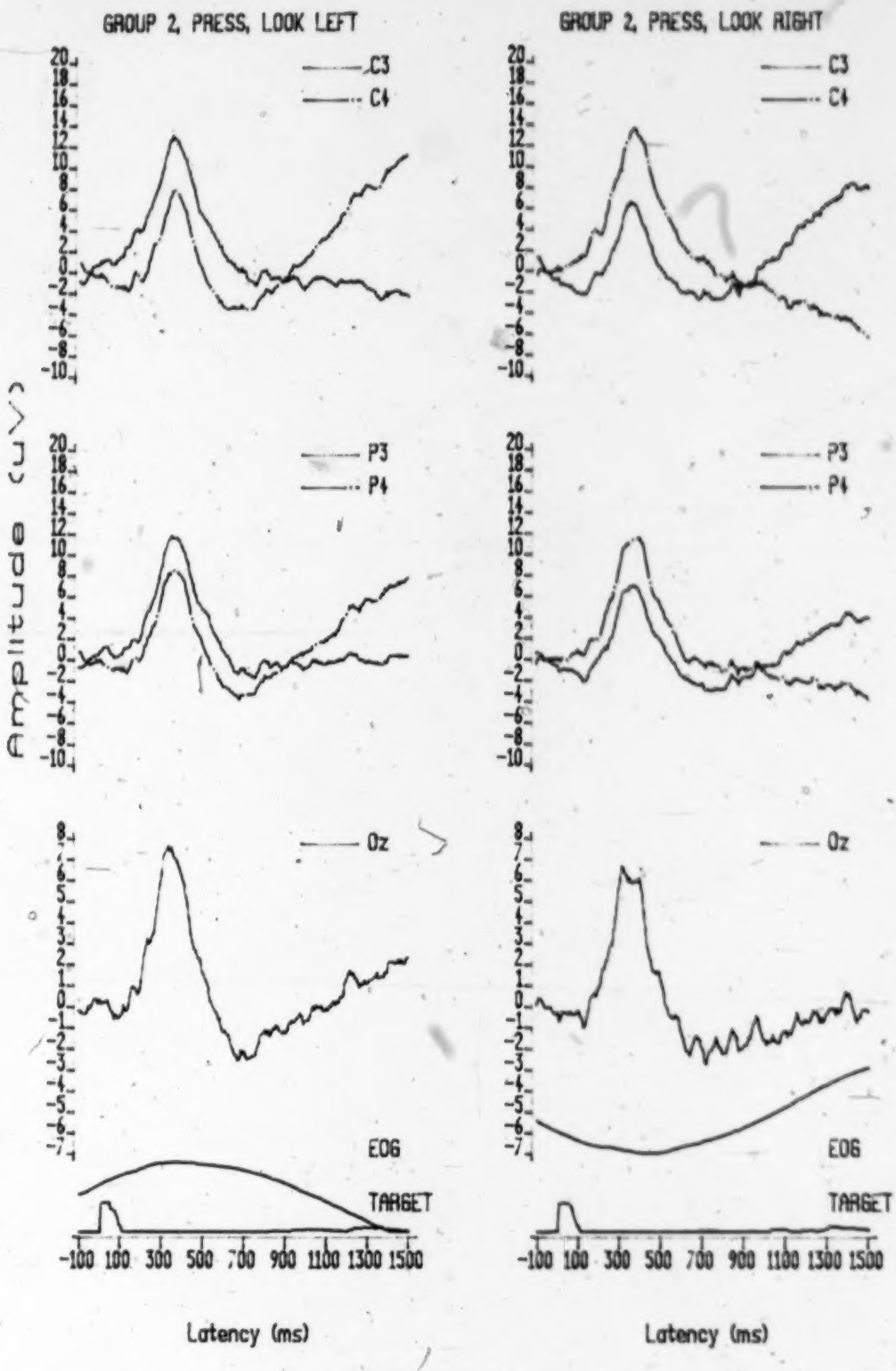
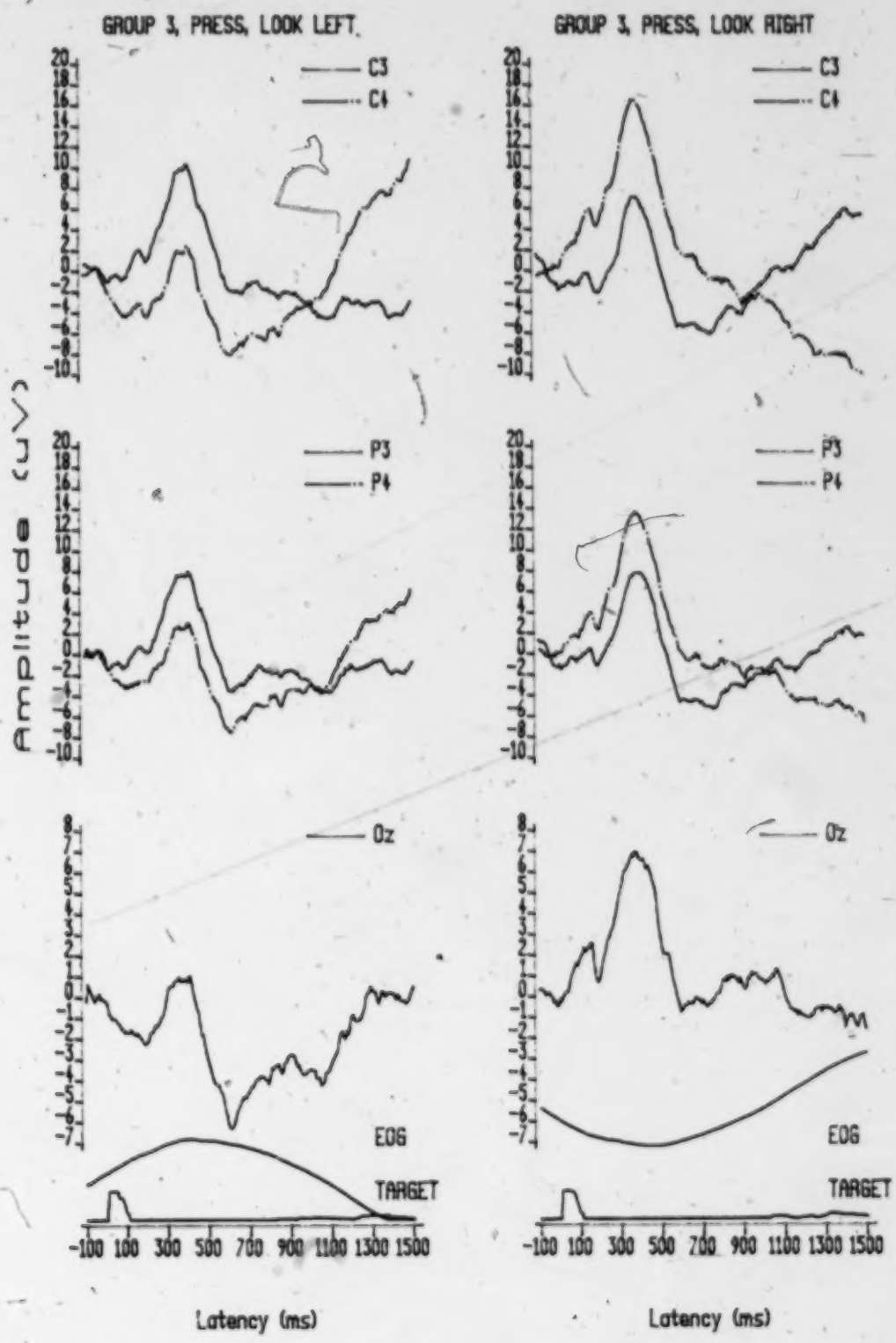

GROUP 2, PRESS, LOOK LEFT
GROUP 2, PRESS, LOOK RIGHT
C3
C4
P3
P4
Oz
EOG
TARGET
Amplitude (uV)
-100 100 300 500 700 900 1100 1300 1500
Latency (ms)

Figure 9c


GROUP 3, PRESS, LOOK LEFT
GROUP 3, PRESS, LOOK RIGHT
C3
C4
P3
P4
Oz
EOG
TARGET
Amplitude (uV)
-100 100 300 500 700 900 1100 1300 1500
Latency (ms)
Latency (ms)

---

insert Figure 10 about here

Also at central sites there was a significant Group X Hemisphere X Condition interaction ($F(2,38)=7.4$, $p<.05$) (Fig. 11). It was found that at C3 during Ignore, both risk groups had larger P300 peaks than the Control group ($TSD(38)=1.42$, $p<.01$). At C4 during Ignore, the same result was found ($p<.01$). What seems to have occured is that risk groups were unable to ignore the irrelevant shape change of the target. During the Press condition, the FR group had larger P300 peaks compared to both other groups at both C3 and C4 sites ($p<.01$). The PR group had elevated P300 peaks as well compared to the Controls at C4 during Press ($p<.01$).

---

insert Figure 11 about here

Almost identical results were found at parietal sites. There was a main effect of Hemisphere ($F(1,38)=5.9$, $p<.05$), with P300 being larger over P4 than over P3. Condition was also significant ($F(1,38)=75.9$, $p<.001$), such that the Press condition elicited greater P300 voltage. There was also a

Figure Caption

Figure 10. P300 responses depending on target direction at central, parietal and occipital locations: A comparison of the three groups

Figure 10

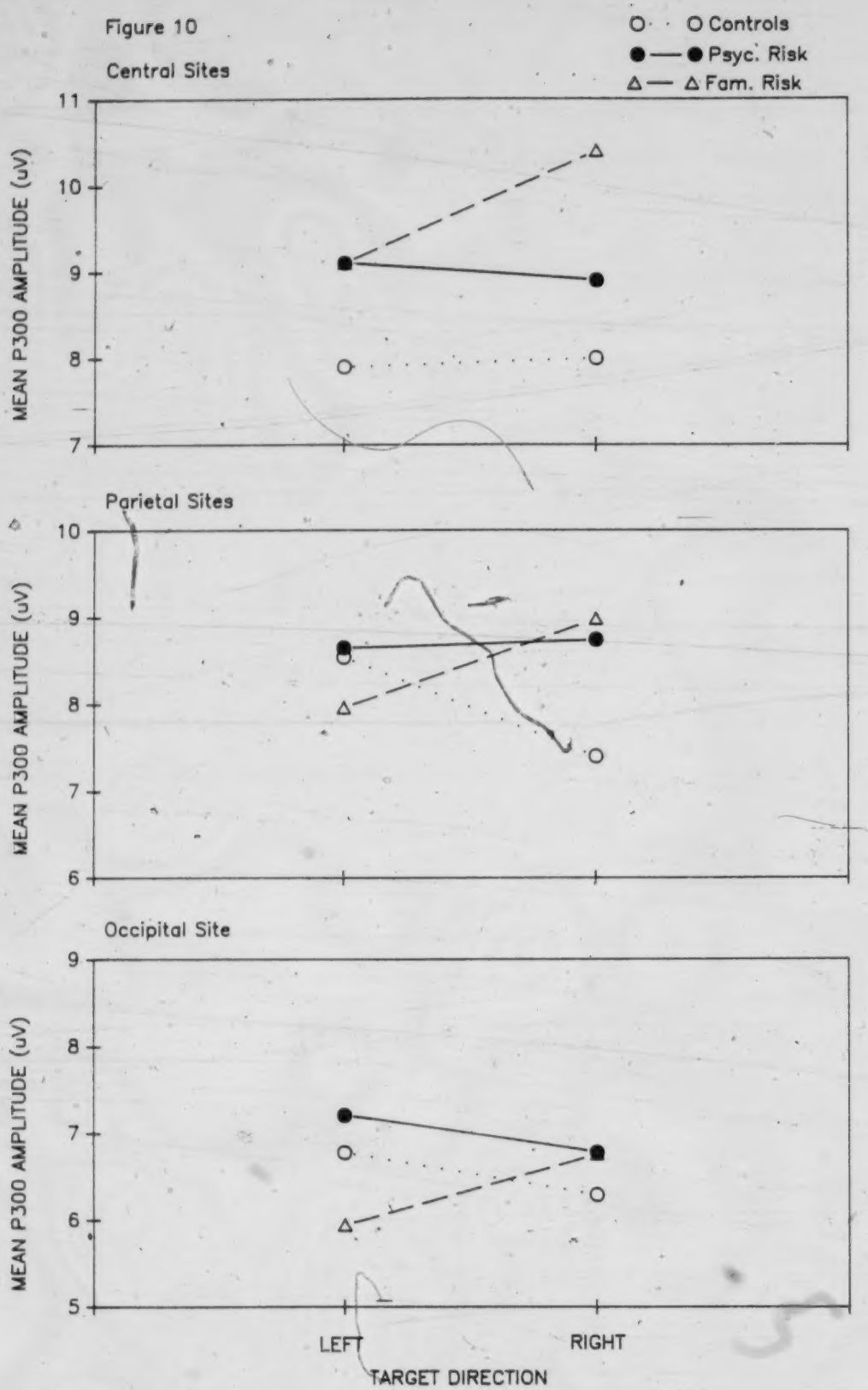
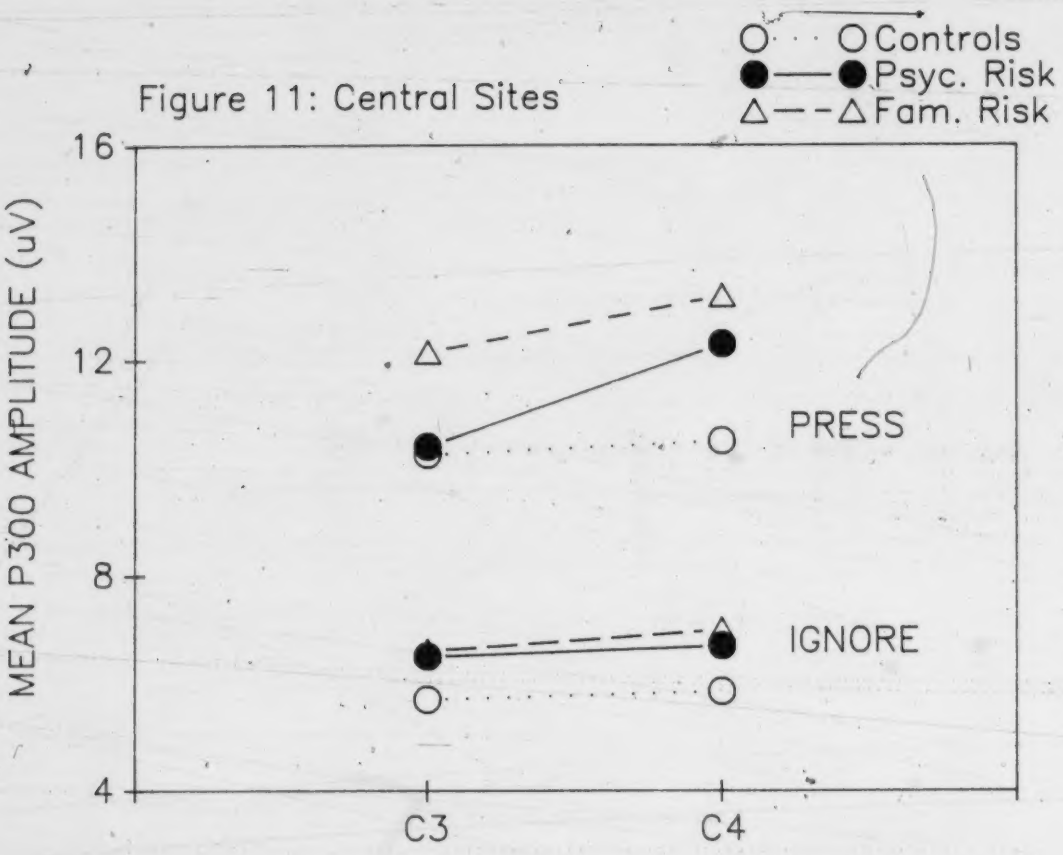

Controls
Psyc. Risk
Fam. Risk
Central Sites
MEAN P300 AMPLITUDE (uV)
11
10
9
8
7
Parietal Sites
MEAN P300 AMPLITUDE (uV)
10
9
8
7
6
Occipital Site
MEAN P300 AMPLITUDE (uV)
9
8
7
6
5
LEFT
RIGHT
TARGET DIRECTION

Figure Caption

Figure 11. Group X Hemisphere X Condition interaction at left (C3) and right (C4) central recording sites: Mean P300 amplitude

Figure 11: Central Sites



statistically significant Direction X Hemisphere interaction ($F(1,38)=47.2$, $p<.001$), which is illustrated in Figures 8 and 9. This effect is essentially identical to that at central areas. Direction X Group was significant at parietal areas as well ($F(1,38)=4.5$, $p<.05$; see Figure 10b). When the target was moving left, FR subjects had smaller P300 peaks than PR subjects ($TSD(38)=2.5$, $p<.05$). When the target was moving right, both risk groups had larger P300 peaks than the Controls ($TSD(38)=3.1$, $p<.01$). These results are similar to those found at central sites: Control subjects had larger P300 peaks when the target was moving left relative to when it was moving right. The FR subjects showed a reverse pattern, and the PR subjects seemed to have had relatively equal P300 amplitudes regardless of target direction.

At Oz, there was a significant difference between P300 amplitudes for the Press and Ignore conditions ($F(1,38)=55.8$, $p<.001$). The Direction X Group interaction is depicted in Figure 10c, but this result did not quite reach statistical significance ($F(1,38)=2.7$, $p<.09$).

ANOVAs were conducted including Group and the hand (left or right) in which the signal box was held as

between-subject variables. Use of the left or right hand was not found to interact with any other variable, so it is believed that it is not an important factor for this type of SPEM task.

In summary, it appears that the risk groups demonstrated normal, if somewhat exaggerated hemispheric patterns of arousal. That is, they experienced greater P300 peaks in the hemisphere ipsilateral to the direction of target movement. However, a few group differences must be pointed out. At both central sites, the FR subjects exhibited significantly greater P300 peaks for the Press and Ignore conditions, and the PR group exhibited significantly greater P300 peaks during Ignore over C3 and C4, and during Press over C4. Thus, heightened voltage was most evident over the right hemisphere in the risk groups. Perhaps related to this, it was more so when the target was moving right as opposed to left (thus implying more use of right hemisphere resources) that the risk groups demonstrated abnormally high P300 peaks. The critical differences between risk and non-risk subjects were that the former showed increased cortical arousal, particularly in the right hemisphere when attentional demands were high and when tracking in a rightward direction. Thus, in a SPEM task where oculomotor activity is comparable for all

groups, risk subjects showed evidence of right hemispheric hyperarousal.

Discussion

Group differences in visual search performance were not statistically reliable, but many researchers such as O'Connor et al. (1987) have found no performance differences while recording ERPs. Since these tasks (in the present study and in the literature) are visuospatial in nature, it is not clear why performance deficits were not found. The lack of performance deficits in these visuospatial tasks and the widespread evidence that alcoholism-risk subjects have visuospatial deficits on a variety of other neurocognitive tasks remains unresolved. One possibilty is that a subject-selection bias occurred, with less visuospatially competent subjects not being enrolled in university. There was a general trend for the risk groups to show some deficits in the visual search tasks, but perhaps these tasks are not difficult enough to elicit group differences among university students. Begleiter et al. (1984) found performance deficits while recording ERPs, perhaps because they used a less biased sample of elementary school-aged boys.

It was evident that risk subjects omitted more

right-sided non-verbal targets than the Control subjects. The results of the study conducted by Bertera and Parsons (1978) suggested that those at risk for alcoholism should make more left-sided errors, presumably because of right hemisphere dysfunction. Unilateral hypoarousal, associated with destructive brain lesions, often produces hemispatial neglect or inattention, especially if the right hemisphere is damaged. Unilateral hypoarousal results in inattention of the hemispace contralateral to the lesion (Heilman and Van Den Abell, 1980). Therefore, the results of the present study, with at-risk subjects demonstrating right-hemispace neglect would not have been expected, if they also had demonstrated right hemisphere hypoarousal.

Left cortical hemisphere dysfunction likely could not account for the increased right-sided errors demonstrated by the risk subjects. There was no evidence from the ERP data during the Search and SPEM tasks that the left hemispheres of the subjects were unusually hyporesponsive. In fact, it was evident that the right cortical hemispheres appeared to be hyperresponsive in the risk subjects. Right hemisphere hypoarousal would likely have resulted in more left-hemispace errors of omission. Furthermore, the nonverbal version of the Search task is believed to be the more taxing of right

hemisphere resources than the verbal version, and it was during the non-verbal task that group differences were found.

Kinsbourne (1987) has proposed a theory to explain unilateral neglect. He has suggested that unilateral neglect arises from an imbalance in an opponent system that controls lateral mechanisms of attention such as orientation and action. Hypoarousal of one hemisphere results in a contralateral bias of the opposite hemisphere. Likewise, excessive activation of one hemisphere leads to a greater inhibition of the other and a consequent relative neglect of the hemispace contralateral to the inhibited hemisphere. The risk subjects in the present study appeared to have excessively active right hemispheres during both SPEM and Search tasks. According to Kinsbourne's (1987) theory, a hyerresponsive right hemisphere should inhibit left hemisphere activity and cause right hemispatial inattention. The more the right hemisphere is activated (such as during the nonverbal Search task), the greater the left hemispace inattention would likely be. It appears that this may have occurred in individuals at risk for developing alcoholism in the present study.

Because the rate of errors was extremely low (usually less than one error per group on average), the

results must be accepted with caution. However, it is likely fair to suggest that the results from the analysis of hemispace of errors provide further evidence that those at risk for alcoholism demonstrate abnormal right hemisphere activity.

ERP differences during the auditory probe Search task were rather striking. The two risk groups had abnormal ERP amplitude patterns, especially during search of verbal arrays. Due to the presumed increased difficulty of the nonverbal task relative to the verbal task, and the belief that it taxes right hemisphere resources more so than does verbal search, it was expected that the non-verbal Search task would draw out group differences compared to the verbal Search task. It is interesting that the risk subjects demonstrated particularly increased right-hemisphere response to the tones during the verbal task, but as Fabian and his associates suggested, perhaps alcoholics do not have the same hemispheric lateralization or specialization that non-alcoholics do (Fabian et al. (1984). Abnormal hemispheric specialization may account for the fact that the verbal Search task performance illustrated group differences most clearly, but it is difficult to determine without further exploration. The Psychometric risk group in particular showed centrally recorded ERPs

which suggested an unusual development of attention during verbal search. Group differences in ERPs recorded from parietal sites were not statistically significant, although it appeared that the risk groups failed to show as strong a right-sided involvement in visual search as the control group. Another interpretation is that the risk subjects were not as capable as the control subjects of inhibiting electrocortical responses to irrelevant information in the right hemisphere. These results concur with Bertera and Parsons's (1978) finding that alcoholics have difficulties with visual search, indicative of reduced right hemisphere ability.

ERPs recorded from central and parietal areas during the SPEM task also suggested that the risk groups had abnormal hemispheric involvement. Again, it appears that the risk groups were abnormally responsive to the target shape change, particularly over the right hemisphere, whether or not it was necessary to pay attention to this stimulus. It also appears that the risk subjects, particularly the FR group, were generally hyperaroused during SPEM, as they had significantly greater P300 peaks. This hyperarousal seems to be exaggerated in the right hemisphere. Some researchers have found that FR subjects (Finn and Pihl, 1987,1988, Levenson et al., 1987) and PR subjects (Levenson et al,

1987) are more responsive to stress than non-risk control subjects, according to cardiac response measures. Schandler et al. (1988b) found that their detoxified alcoholic subjects remained more physiologically aroused than intoxicated alcoholics while learning a task. Perhaps uninhibited, impulsive and distractible behaviour is related to central and autonomic activational abnormalities. Perhaps, as Schandler et al. (1988b) suggested, alcohol reduces this hyperarousal and improves attention.

It is difficult to explain why the risk subjects in the present study demonstrated greater P300 peaks, while most researchers have found decreased P300 amplitude in their COA subjects. However, in most studies (eg. O'Connor et al., Whipple et al., 1988) P300 responses were elicited by complex cognitive tasks. The SPEM task requires vigilance and heightened attention, especially during the Press condition, but likely little cognitive processing per se. Thus, the risk groups seemed to have demonstrated anomolous arousal as if they had trouble concentrating or directing their attention. This supports published research that alcoholics report more behaviour problems such as hyperactivity, attentional problems, and conduct disorder in childhood (Schaeffer et al., 1988; Alterman et al., 1989), and

that alcoholism risk subjects are less able to direct their attention during cognitive tasks (Drejer et al., 1985; Tarter et al., 1989).

Taken together, the ERP results from the search and SPEM tasks suggest that a psychophysiological basis for visuospatial dysfunction in alcoholism-prone individuals is right-hemisphere over-activation. This may contribute to inefficient allocation of processing resources between relevant and irrelevant sources of environmental information in more complex cognitive tasks.

The group differences on the psychometric indices must be mentioned. On the psychometric indices, both risk groups demonstrated higher scores on the MAC test, with the greatest difference in scores being between the Controls and the PR subjects as expected. FR subjects had slightly higher scores on the MAC than the Control subjects, perhaps because some inherited personality traits associated with alcoholism, such as hostility and impulsivity, are naturally present in COAs. Saunders and Schuckit (1981) found that those individuals with alcoholic relatives scored significantly higher on the MAC than those with no alcoholic relatives. MacAndrew (1965) suggested a cut-off score of greater than or equal to 24 for a person to be considered alcoholic.

Using this criterion, all PR subjects would be considered alcoholic, which is not likely the case as they did not drink more or report higher MAST scores compared to the other two groups.

The Family Risk subjects were also different from the Controls in that they tended to believe more strongly that alcohol consumption improves or enhances sexual activity. Brown (1985) found that problem drinkers believed that consumption reduced tension (and not necessarily improved sexual functioning). Since Brown found that expectancy measures did not seem to predict drinking among non-problem drinkers (those who drank only according to context or situational cues), and since the groups in the present study were relatively equal in terms of drinking habits and experiences, it is not surprising that most expectancy items did not differentiate the groups. Teahan (1988), using a different psychometric measure of expectancy, found that the highest expectancy with alcohol consumption among Canadian alcoholic men was sexual enhancement. Sexual enhancement was not significantly related to MAC nor quantity and frequency of drinking in the present study, so perhaps it is an orthogonal measure of risk that should be pursued.

Finally, the FR subjects may have been more

depressed than the others, two of them clinically depressed. A clear connection between depression and alcoholism risk has not been established, so this result is a bit surprising. For example, Parker and Harford (1988) recently demonstrated that sons of alcoholics were more at risk for problem drinking, while only daughters were more vulnerable for developing depression. Heltzer and Prysbeck (1988) asserted that, for 78 percent of male alcoholics, depression occurred after the onset of alcoholism. Schaeffer et al. (1988) reported that the FR subjects in their study reported more symptoms of depression, but did not offer explanations. Thus, the relationship between risk for alcoholism and depression remains unanswered.

There are a few shortcomings to the present study that must be addressed. First, all personal information provided by the subjects was based on self-report and must be presumed to be reliable. Also, diagnosis of family alcoholism was not necessarily based on specific diagnostic criteria (such as the DSM-III). Thus, it is difficult to be certain of the gravity of problem drinking among relatives. It would have been ideal to provide both the subjects and their relatives with a alcoholism checklist based on the DSM-III so an accurate diagnosis of alcoholism could have been available.

However, subjects were carefully selected and matched, and demographic information was confirmed at an interview. It was assumed that these young men would be capable of accurately reporting whether or not a relative was an alcoholic. Finally, the Family risk subjects may have been more depressed than those in the other groups. It would be wise to get larger groups of subjects and exclude those who are clinically depressed, as performance has been found to be abberant (particularly slower) in depressed individuals (Davison and Neale, 1982).

This study provides some advantages over previously published research. First, two types of risk for alcoholism were included, while most researchers have examined only family risk or psychomtric risk separately. The "exophenotypic" approach was quite productive, as it was discovered that those individuals who are at risk for alcoholism merely on the basis of psychometric responses have psychophysiological responses comparable to those with proven family risk. The findings of Levenson et al. (1987) concur with the present results; that both family and psychometric risk may be useful indices of vulnerability for the development of alcoholism.

Second, both visuospatial performance and

electrocortical activity were measured simultaneously in the subjects to allow for direct comparisons. Third, ERPs were compared across hemispheres in order to examine potential hemispheric asymmetry problems. Despite the widespread belief that alcoholics and those at risk for alcoholism have limited right hemisphere capacity, it has not been examined directly, according to published literature. O'Connor et al. (1987) found reduced P300 peaks at right parietal sites, but offered no hypothesis about the implications of this result.

It may be premature to claim that alcoholism-risk subjects have right hemisphere hyperactivity, but the data in the present study tend to support this contention. Therefore, it may be fruitful to examine right hemisphere activity during a variety of divided attention tasks with alcoholism-risk subjects. Attentional problems due to hemispheric abnormalities during visuospatial tasks may be markers for susceptibilty for the development of alcoholism.

Reference Notes

1. Jutai, J., Aubrey, J., Roberts, L. and Finlay, G. Effects of memory set size on visual search of verbal and nonverbal arrays. Manuscript in preparation.

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Appendix A

General Attitudes Questionaire

Please circle either T (true) or F (false) beside each of the following statements to indicate whether or not it applies to you. Be sure to respond to every statement. Do not circle both T and F in response to any statement.

T F 1. I have had periods in which I carried on activities without knowing later what I had been doing.

T F 2. I have never been in trouble with the law.

T F 3. I have not lived the right kind of life.

T F 4. I like to cook.

T F 5. I sweat very easily even on cool days.

T F 6. My parents have often objected to the kind of people I went around with.

T F 7. I played hooky from school quite often as a youngster.

T F 8. I would like to wear expensive clothes.

T F 9. As a youngster I was suspended from school one or more times for cutting up.

T F 10. While in trains, buses, etc., I often talk to strangers.

T F 11. I pray several times every week.

T F 12. I deserve severe punishment for my sins.

T F 13. I have had blank spells in which my activities were interupted and I did not know what was going on around me.

T F 14. I have a cough most of the time.

T F 15. I do not like to see women smoke.

T F 16. My table manners are not quite as good at home as when I am out in company.

T F 17. I have few or no pains.

T F 18. I do many things which I regret afterwards (I regret things more or more often than others seem to).

T F 19. I like to read newspaper articles on crime.

T F 20. I am worried about sex matters.

T F 21. My soul sometimes leaves my body.

T F 22. Christ performed miracles such as changing water into wine.

T F 23. I know who is responsible for most of my troubles.

T F 24. The sight of blood neither frightens me or makes me sick.

T F 25. I cannot keep my mind on one thing.

T F 26. In school I was sometimes sent to the principal for cutting up.

T F 27. The one to whom I was most attached and whom I most admired as a child was a woman. (Mother, sister, aunt, or other woman).

T F 28. I have more trouble concentrating than others seem to have.

T F 29. I am a good mixer.

T F 30. I enjoy a race or game better when I bet on it.

T F 31. I enjoy gambling for small stakes.

T F 32. I freqently notice my hand shakes when I try to do something.

T F 33. Everything is turning out just like the prophets of the Bible said it would.

T F 34. If I were in trouble with several friends who were equally to blame, I would rather take the whole blame than to give them away.

T F 35. I was fond of excitement when I was young (or in childhood).

T F 36. I have at times had to be rough with people who were rude or annoying.

T F 37. If I were a reporter I would very much like to report sporting news.

T F 38. I am certainly lacking in self-confidence.

T F 39. I have frequently worked under people who seem to have things arranged so that they get credit for good work but are able to pass off mistakes onto those under them.

T F 40. I readily become one hundred percent sold on a good idea.

T F 41. I think I would like the kind of work a forest ranger does.

T F 42. Evil spirits possess me at times.

T F 43. Many of my dreams are about sex matters.

T F 44. I liked school.

T F 45. I have been quite independent and free from family rule.

T F 46. I have often felt that strangers were looking at me critically.

T F 47. I used to keep a diary.

T F 48. I seem to make friends about as quickly as others do.

T F 49. I have never vomited blood or coughed up blood.

T F 50. A few drinks makes it more difficult to talk to people.

T F 51. Drinking helps to put me in a depressed mood.

T F 52. Drinking can make me more satisfied with myself.

T F 53. I am a better lover after a few drinks.

T F 54. I feel powerful when I drink as if I can really influence people.

T F 55. Alcohol acts as an anesthetic, that is, it decreases pain.

T F 56. Sometimes when I drink alone or with one other person it is easy to feel cozy and romantic.

T F 57. If I am tense or anxious, having a few drinks gives a sense of warmth.

T F 58. Drinking decreases male aggressiveness.

T F 59. After a few drinks, I feel less self-reliant than usual.

T F 60. Drinking makes me feel good.

T F 61. After a few drinks, I feel brave and more capable of fighting.

T F 62. Alcohol disrupts my sleep (I don't sleep as well after drinking).

T F 63. If I am cold, having a few drinks gives me a sense of warmth.

T F 64. I feel less masculine after a few drinks.

T F 65. When I drink, it is easier to open up and express my feelings.

T F 66. Alcohol makes me feel sad.

T F 67. Alcohol makes me feel better physically.

T F 68. Alcohol makes me worry more.

T F 69. I enjoy sex less if I have some alcohol.

T F 70. After a few drinks I feel more sexually inhibited.

T F 71. I don't drink when I am feeling mad.

T F 72. I am more romantic when I drink.

T F 73. If I have a couple of drinks, it is easier to express my feelings.

T F 74. I feel less creative after I've been drinking.

T F 75. Having a few drinks makes me more tense in a social situation.

T F 76. After a few drinks, it is more difficult to pick a fight.

T F 77. Drinking makes it easier to concentrate on the good feelings I have at the time.

T F 78. A few drinks makes me feel less shy.

T F 79. It is easier for me to meet new people after I've been drinking.

T F 80. I find that conversing with members of the opposite sex is harder for me after I have a few drinks.

T F 81. I feel less coordinated after I drink.

T F 82. Having a few drinks helps me relax in a social situation.

T F 83. I am more tense if I am drinking.

T F 84. When they drink, women become less sexually relaxed.

T F 85. Alcohol makes me feel more interesting.

T F 86. Alcohol increases muscular tension.

T F 87. Alcohol enables me to fall asleep more easily.

T F 88. After a few drinks, I am less sexually responsive.

T F 89. At times, drinking is like permission to forget problems.

Appendix B

Background Information:

1. My parents are (a) still married
   (b) divorced
   (c) separated
   (d) one parent has died (please state which parent and when the parent died)_____
   (e) both parents died (please say when each died)_____
   _____

2. I was adopted and therefore know nothing about my biological relatives:

   Yes_____ No_____

If you answered Yes to this question (ie. you were adopted), please skip over the next several questions and resume at Question 13.

For the next several questions, if you don't know the answer, say so and indicate why you don't know. Please do not leave any item blank.

3. Name the race (Caucasion, Black etc.) of your biological mother:
   _____

4. Name the race of your biological father:
   _____

5. Name the country in which your biological mother grew up:
   _____

6. Name the country in which your biological father grew up:
   _____

7. How often did your biological mother consume alcohol while she was pregnant with you or while she was breast-feeding you? (circle one)

   (a) often (a couple of drinks per day)
   (b) sometimes (several drinks a week)
   (c) seldom (no more than once a week)
   (d) not at all
   (e) don't know (please specify why) _____

8. Is your father (a) your biological father
   (b) a step, adoptive, or foster father
   (c) I was not raised by a father

9. Is your mother (a) your biological mother
   (b) a step, adoptive, or foster mother
   (c) I was not raised by a mother

For items 10-12, please consider biological/blood relatives only:

10. Is your mother (a) an alcoholic or problem drinker
(b) a recovering or recovered alcholic/problem drinker
(c) a social drinker
(d) a non drinker
(e) I don't know (please specify why)

_____

11. Is your father (a) an alcoholic or problem-drinker
(b) a recovering or recovered alcoholic/problem drinker
(c) a social drinker
(d) a non-drinker
(e) I don't know (please specify why)

_____

12. Please indicate (i) which of the following by circling and
(ii) how many of the following in brackets
biological or blood relatives are problem drinkers, alcoholics, or recovered alcoholics:

(a) brother ( )	(b) sister ( )
(c) father's brother ( )	(d) father's sister ( )
(e) mother's brother ( )	(f) mother's sister ( )
(g) father's father ( )	(h) father's mother ( )
(i) mother's father ( )	(j) mother's mother ( )
(k) your son ( )	(l) your daughter ( )

Please answer the following questions, circling only one response per item:

13. With one drink = one beer = one cooler or cider = one glass of wine = one mixed drink = one straight shot = 18 ml absolute alcohol.
How many drinks do you typically drink per occasion?

_____drinks

14. How frequently do you consume alcohol?

(a) more than once per day
(b) once a day or almost every day
(c) a few times per week
(d) once a week
(e) once or twice a month
(f) a few times per year
(g) never or almost never

15. Please put a number in the space provided beside each type of alcoholic beverage corresponding to your order of preference. (That is, for the drink you typically consume, put a "1" beside it, and for the beverage you'd likely drink the second most often, put a "2" beside it, and so on).

_____beer
_____wine
_____cooler or cider
_____mixed drink
_____straight shot

16. With reference again to the guide provided in question 13 about how many drinks does it take you to get drunk?

_____drinks

17. How many times per month do you get drunk?

_____times per month

For the following ten questions, please circle Y (yes) or N (no):

Y N 18. Do you feel you are a normal drinker?

Y N 19. Do your friends or relatives think you are a normal drinker?

Y N 20. Have you ever attended a meeting of Alcoholics Anonomous (AA)?

Y N 21. Have you ever lost friend(s) or girlfriend(s)/boyfriend(s) because of drinking?

Y N 22. Have you ever gotten into trouble at work because of drinking?

Y N 23. Have you ever neglected obligations, your family or your work for two or more days in a row because you were drinking?

Y N 24. Have you ever had delirium tremens (DT's), severe shaking, heard voices, or seen things that weren't there after heavy drinking?

Y N 25. Have you ever gone to anyone for help about your drinking?

Y N 26. Have you ever been in a hospital because of drinking?

Y N 27. Have you ever been arrested for drunk driving or driving after drinking?

Y N 28. Have you ever been hospitalized for a head injury (for example concussion, loss of consciousness etc.)?

Appendix C

Activities and Preferences Questionnaire

Circle either T (True) or F (False) beside each of the following statements to indicate whether or not it applies to you. Please be sure to respond to every statement. Do not circle both T and F in response to any statement.

T F 1. The beauty of sunsets is greatly overrated.

T F 2. I have sometimes danced by myself just to feel my body move with the music.

T F 3. When I start out in the evening I seldom know what I'll end up doing.

T F 4. Once in a while I think of things too bad to talk about.

T F 5. I find it difficult to remain composed when I get into an argument.

T F 6. Having close friends is not as important as many people say.

T F 7. Some people can make me aware of them just by thinking about me.

T F 8. Sometimes I have had feelings that I am united with an object near me.

T F 9. I often get so mad that I lose track of some of the things I say.

T F 10. I have seldom cared to sing in the shower.

T F 11. I have sometimes had the feeling that one of my arms or legs is disconnected from the rest of my body.

T F 12. I have had the momentary feeling that I might not be human.

T F 13. I attach very little importance to having close friends.

T F 14. After a busy day, a slow walk has often felt relaxing.

T F 15. I do many things that seem strange to others but don't seem strange to me.

T F 16. I have often enjoyed receiving a strong, warm handshake.

T F 17. At times I feel like swearing.

T F 18. I usually act first and ask questions later.

T F 19. I prefer watching television to going out with other people.

T F 20. I have sometimes been fearful of stepping on sidewalk cracks.

T F 21. I sometimes have to touch myself to make sure I'm still there.

T F 22. The sounds of a parade have never excited me.

T F 23. If I burped loudly while having dinner at the house of someone I knew, I would be embarrased.

T F 24. I never get so angry I can't speak coherently.

T F 25. When eating a favorite food, I have often tried to eat slowly to make it last longer.

T F 26. Sometimes I have had the feeling that a part of my body is larger than it usually is.

T F 27. I think I could learn to read others minds if I wanted to.

T F 28. A car ride is much more enjoyable if someone is with me.

T F 29. On seeing a soft, thick carpet, I have sometimes had the impulse to take off my shoes and walk barefoot on it.

T F 30. One food tastes as good as another to me.

T F 31. I usually laugh out loud at clumsy people.

T F 32. I like to use obscene language to shock people.

T F 33. I do not always tell the truth.

T F 34. I like to make long distance phone calls to friends and relatives.

T F 35. Horoscopes are right too often for it to be a coincidence.

T F 36. At times I have wondered if my body was really my own.

T F 37. As often as once a month I have become so angry that I have had to hit something or someone to relieve my anger.

T F 38. I have had very little fun from physical activities like walking, swimming, or sports.

T F 39. Parts of my body occasionally seem dead or unreal.

T F 40. I prefer being spontaneous rather than planning ahead.

T F 41. Things sometimes seem to be in different places when I get home, even though no one has been there.

T F 42. When I pass by flowers, I have often stopped to smell them.

T F 43. Playing with children is a real chore.

T F 44. I try to remember to send people birthday cards.

T F 45. Sex is okay, but not as much fun as most people claim it is.

T F 46. I have often found walks to be relaxing and enjoyable.

T F 47. I have always enjoyed looking at photographs of friends.

T F 48. Sometimes I have had a passing thought that some part of my body was rotting away.

T F 49. I do not read every editorial in the newspaper every day.

T F 50. Standing on a high place and looking out over the view is very exciting.

T F 51. Numbers like 13 and 7 have no special powers.

T F 52. I usually control my feelings well.

T F 53. I often do unusual things just to be different from other people.

T F 54. Although there are things that I enjoy doing by myself, I usually seem to have more fun when I do things with other people.

T F 55. I have occasionally had the silly feeling that a TV or radio broadcaster knew I was listening to him.

T F 56. Trying new foods is something I have always enjoyed.

T F 57. I have never found a thunderstorm exhilarating.

T F 58. The bright lights of a city are exciting to look at.

T F 59. Occasionally I have felt as though my body did not exist.

T F 60. Being in debt would worry me.

T F 61. I have worried that people on other planets may be influencing what happens on earth.

T F 62. Sometimes I have felt that I could not distinguish my body from other objects around me.

T F 63. I sometimes become deeply attached to people I spend a lot of time with.

T F 64. I have often felt uncomfortable when my friends touch me.

T F 65. I get angry sometimes.

T F 66. I break rules just for the hell of it.

T F 67. I liked to annoy my high school teachers.

T F 68. The government refuses to tell us the truth about flying saucers.

T F 69. People sometimes think that I am shy when I really just want to be left alone.

T F 70. I've never cared much about the texture of food.

T F 71. When I have walked by a bakery, the smell of fresh bread has often made me hungry.

T F 72. It has seemed at times as if my body was melting into my surroundings.

T F 73. Long-term goals are not as important for me as living for today.

T F 74. When things are going really good for my close friends, it makes me feel good too.

T F 75. I have felt that there were messages for me in the way things were arranged, like in a store window.

T F 76. I have never felt that my arms or legs have momentarily grown in size.

T F 77. I usually quit before finishing one activity in order to start something else.

T F 78. Thinking things over too carefully can destroy half the fun of doing them.

T F 79. Poets always exaggerate the beauty and joys of nature.

T F 80. The boundaries of my body always seem clear.

T F 81. Once in a while I put off until tomorrow what I ought to do today.

T F 82. I have never doubted that my dreams are the products of my own mind.

T F 83. When someone close to me is depressed, it brings me down also.

T F 84. I wouldn't worry much if my bills were overdue.

T F 85. Most people think of me as reckless.

T F 86. It worries me if I know there are mistakes in my work.

T F 87. My emotional responses seem very different from those of other people.

T F 88. Beautiful scenery has been a great delight to me.

T F 89. People who drive carefully annoy me.

T F 90. I usually find myself doing things "on impulse".

T F 91. It has always made me feel good when someone I care about reaches out to touch me.

T F 92. Good luck charms don't work.

T F 93. I can remember when it seemed as though one of my limbs took on an unusual shape.

T F 94. I have sometimes had the feeling that my body is abnormal.

T F 95. In school I sometimes got in trouble for cutting up.

T F 96. My parents often objected to the kind of people I went around with.

T F 97. Sometimes when I am not feeling well I am cross.

T F 98. It has often felt good to massage my muscles when they are tired or sore.

T F 99. I have always loved having my back massaged.

T F 100. The sound of organ music has often thrilled me.

T F 101. When I am home alone, I often resent people telephoning me or knocking on my door.

T F 102. I have noticed sounds on my records that are not there at other times.

T F 103. Just being with friends can make me feel really good.

T F 104. The first winter snowfall has often looked pretty to me.

T F 105. I think that flying a kite is silly.

T F 106. My way of doing things is apt to be misunderstood by others.

T F 107. When I really want something, I don't care how much it costs.

T F 108. I have sometimes had the feeling that my body is decaying inside.

T F 109. The hand motions that strangers make seem to influence me at times.

T F 110. When things are bothering me, I like to talk to other people about it.

T F 111. I have never been in trouble with the law.

T F 112. The sound of rustling leaves has never much pleased me.

T F 113. My table manners are not quite as good at home as when I am out in company.

T F 114. I have usually found soft music boring rather than relaxing.

T F 115. I prefer hobbies and leisure activities that do not involve other people.

T F 116. No one seems to understand me.

T F 117. I let go and yell a lot when I'm mad.

T F 118. I have had the momentary feeling that the things I touch remain attached to my body.

T F 119. I almost never dream things before they happen.

T F 120. I've never cared to sunbathe; it just makes me hot.

T F 121. The sound of the rain falling on the roof has made me feel snug and secure.

T F 122. The smell of dinner cooking has hardly every aroused my appetite.

T F 123. I have usually finished my bath or shower as quickly as possible just to get it over with.

T F 124. My friends consider me to be a cool, controlled person.

T F 125. I always stop at red lights.

T F 126. I have had the momentary feeling that someone's place has been taken by a look-alike.

T F 127. Occasionally it has seemed as if my body had taken on the appearance of another person's body.

T F 128. It's fun to sing with other people.

T F 129. If I could get into a movie without paying and be sure I was not seen I would probably do it.

T F 130. I rarely act on impulse.

T F 131. I like playing with and petting soft little kittens or puppies.

T F 132. It's important to save money.

T F 133. When I'm feeling a little sad, singing has often made me feel happier.

T F 134. I usually consider different viewpoints before making a decision.

T F 135. It is not possible to harm others merely by thinking bad thoughts about them.

T F 136. Knowing that I have friends who care about me gives me a sense of security.

T F 137. Sometimes I feel like everything around me is tilting.

T F 138. I have had very little desire to try new kinds of food.

T F 139. I don't understand why people enjoy looking at the stars at night.

T F 140. I have always had a number of favorite foods.

T F 141. I always let people know how I feel about them, even if it hurts them a little.

T F 142. It would embarass me a lot to have to spend a night in jail.

T F 143. I have sometimes sensed an evil presence around me, although I could not see it.

T F 144. When I move to a new city, I feel a strong need to make new friends.

T F 145. I would rather win than lose in a game.

T F 146. Sunbathing isn't really more fun than lying down indoors.

T F 147. I would probably purchase stolen merchandise if I knew it was safe.

T F 148. I have always hated the feeling of exhaustion that comes from vigorous activity.

T F 149. Ordinary colors sometimes seem much too bright to me (without taking drugs).

T F 150. I sometimes have a feeling of gaining or losing energy when certain people look at me or touch me.

T F 151. People are usually better off if they stay aloof from emotional involvements with most others.

T F 152. I don't know why some people are so interested in music.

T F 153. Flowers aren't as beautiful as many people claim.

T F 154. The warmth of an open fireplace hasn't especially soothed and calmed me.

T F 155. I almost always do what makes me happy now, even at the expense of some distant goal.

T F 156. Sex is the most intensely enjoyable thing in life.

T F 157. Although I know I should have affection for certain people, I don't really feel it.

T F 158. My hands or feet have never seemed far away.

T F 159. I have sometimes had the passing thought that strangers are in love with me.

T F 160. I have sometimes felt that some part of my body no longer belonged to me.

T F 161. I like to know some importnat people becuase it makes me feel important.

T F 162. The color that things are painted has seldom mattered to me.

T F 163. People often expect me to spend more time talking with them than I would like.

T F 164. I have had to invent some good excuses to get out of work or taking exams.

T 165. I have never had the feeling that certain thoughts of mine really belonged to someone else.

T F 166. Most of the mourners at funerals are just pretending to be sad.

T F 167. I have seldom enjoyed any kind of sexual experience.

T F 168. I feel pleased and gratified as I learn more and more about the emotional life of my friends.

T F 169. When others try to tell me about their problems and hang-ups, I usually listen with interest and attention.

T F 170. On hearing a good song I have seldom wanted to sing along with it.

T F 171. I have felt that something outside my body was a part of my body.

T F 172. When introduced to strangers, I rarely wonder whether I have known them before.

T F 173. I have often enjoyed the feel of silk, velvet, or fur.

T F 174. Most people say "please" and "thank you" more often than is necessary.

T F 175. If reincarnation were true, it would explain some unusual experiences I have had.

T F 176. I never had really close friends in high school.

T F 177. I do not like everyone I know.

T F 178. I have felt that my body and another person's body were one and the same.

T F 179. I have usually found lovemaking to be intensely pleasurable.

T F 180. I am usually content to just sit alone, thinking and daydreaming.

T F 181. I'm much too independent to really get involved with other people.

T F 182. Now and then when I look in the mirror, my face seems quite different than usual.

T F 183. I avoid trouble whenever I can.

T F 184. I never wanted to go on any of the rides at an amusement park.

T F 185. I never have the desire to take off my shoes and walk through a puddle barefoot.

T F 186. I have felt as though my head or limbs were somehow not my own.

T F 187. People often behave so strangely that one wonders if they are part of an experiment.

T F 188. Sometimes when I look at things like tables and chairs, they seem strange.

T F 189. There are few things more tiring than to have a long, personal discussion with someone.

T F 190. There just are not many things that I have every really enjoyed doing.

T F 191. It made me sad to see all my high school friends go their separate ways when high school was over.

T F 192. I have often found it hard to resist talking to a good friend, even when I have other things to do.

T F 193. I gossip a little at times.

T F 194. I have sometimes enjoyed feeling the strnegth in my muscles.

T F 195. I sometimes do dangerous things just for the thrill of it.

T F 196. At times I perform certain little rituals to ward off negative influences.

T F 197. Making new friends isn't worth the energy it takes.

T F 198. I have never had the passing feeling that my arms or legs had become longer than usual.

T F 199. I have always found organ music dull and unexciting.

T F 200. A good soap lather when I'm bathing has sometimes soothed and refreshed me.

T F 201. I sometimes have had the feeling that some parts of my body are not attached to the same person.

T F 202. I don't have much sympathy for people whom I can push around and manipulate easily.

T F 203. There are things that are more important to me than privacy.

T F 204. I have had the momentary feeling that my body has become misshapen.

T F 205. People who try to get to know me better usually give up after awhile.

T F 206. A brisk walk has sometimes made me feel good all over.

T F 207. When I want something, delays are unbearable.

T F 208. I could be happy living all alone in a cabin in the woods or mountains.

T F 209. Sometimes at elections I vote for people about whom I know very little.

T F 210. Sometimes part of my body has seemed smaller than it usually is.

T F 211. I have been fascinated with the dancing of flames in a fireplace.

T F 212. My hearing is sometimes so sensitive that ordinary sounds become uncomfortable.

T F 213. If given the choice, I would much rather be with others than be alone.

T F 214. I have felt that I might cause something to happen just by thinking too much about it.

T F 215. The taste of food has always been important to me.

T F 216. Sometimes people whom I know well begin to look like strangers.

T F 217. I find that people too often assume that their daily activities and opinions will be interesting to me.

T F 218. I have wondered whether the spirits of the dead can influence the living.

T F 219. I have sometimes felt confused as to whether my body was really my own.

T F 220. I frequently overeat and wonder why later.

T F 221. When I have seen a statue I have had the urge to feel it.

T F 222. I don't really feel very close to my friends.

T F 223. At times I have felt that a professor's lecture was meant especially for me.

T F 224. Often I have a day when indoor lights seem so bright that they bother my eyes.

T F 225. Once in a while I laugh at a dirty joke.

T F 226. During one period when I was a youngster I engaged in petty thievery.

T F 227. Dancing, or the idea of it, has always seemed dull to me.

T F 228. My relationships with other people never get very intense.

T F 229. I have sometimes felt that strangers were reading my mind.

T F 230. For several days at a time I have had such a heightened awareness of sights and sounds that I cannot shut them out.

T F 231. In many ways, I prefer the company of pets to the company of people.

T F 232. I think people spend too much time safeguarding their future with savings and insurance.

Appendix D

PROJECT CONSENT FORM (G)

The purpose of this research is to examine the relationship between personality, brain electrical activity, and performance on attentional tasks.

We will attach several small sensors to your scalp and face. These are used to detect changes in the electrical signals produced by your brain. The attachment and electrical recording procedures are painless and will not damage or discolour your skin or hair. No electrical currents will be passed through your body. The sensors do not penetrate your skin, they merely sit on the skin surface and act like microphones to help us record signals produced by your brain.

You will then be asked to sit quietly and to try to relax for a few minutes. Then you will be asked to do some short tasks involving information presented to you by microcomputer on a display screen, with a brief break between tasks.

It takes approximately 40-50 minutes to complete these activities. You have the right to withdraw from this study at any time without penalty of any kind.

The confidentiality of any information which you give us will be guaranteed.

If you have understood the above, and are satisfied with the experimenter's description of your participation in this research, please complete the bottom portion of this form.

I _____ hereby acknowledge that I have fully
(print your full name)

understood the terms and conditions under which I will participate in this research.

_____
(signature)

_____
(date)

Project Director: Becky Mills
Department: Psychology

Signature of Experimenter: _____

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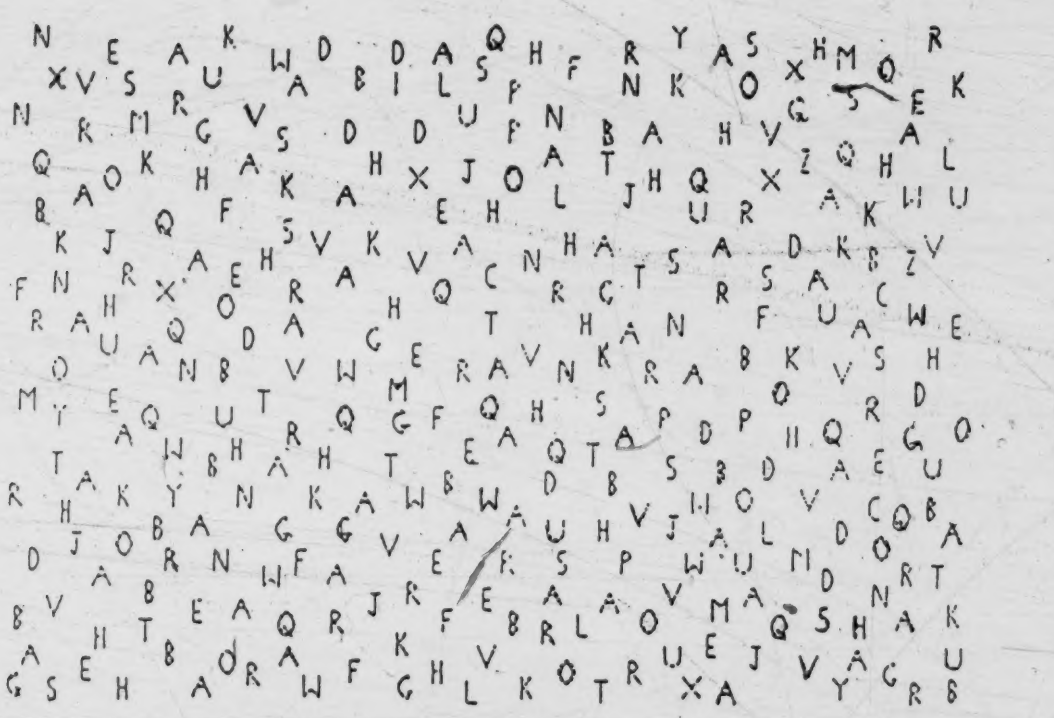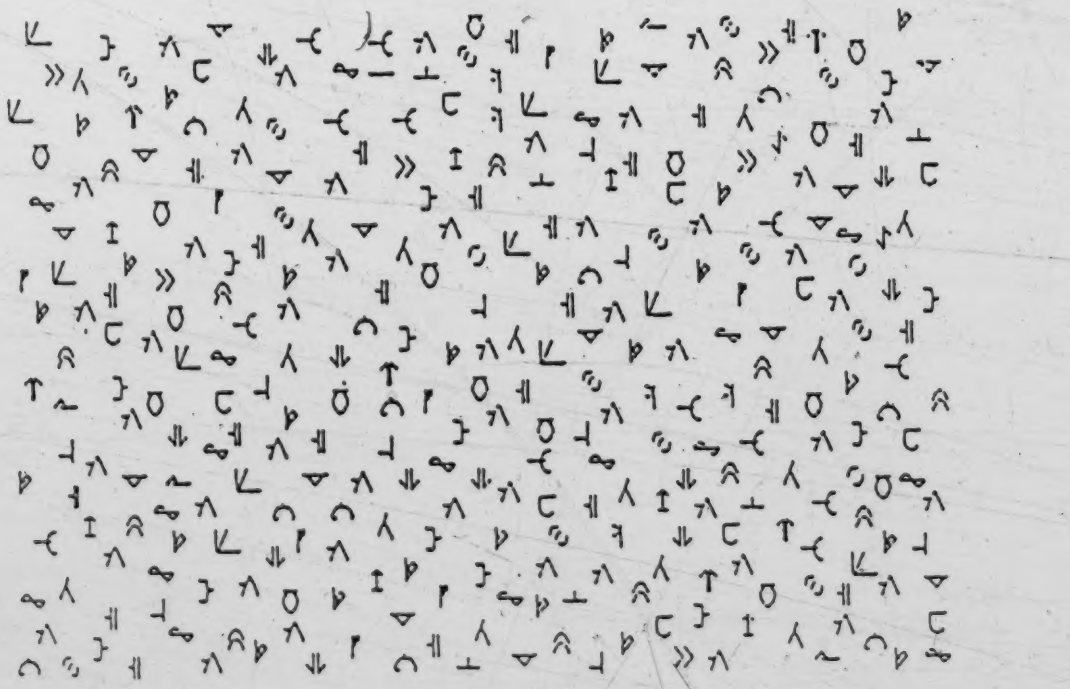
Appendix F: Mesulam Cancellation Tasks